Vol. 14, No. 01, pp. 440-450, 2024 DOI: 10.23960/jpp.v14.i1.202432

Jurnal Pendidikan Progresif

e-ISSN: 2550-1313 | p-ISSN: 2087-9849

http://jurnal.fkip.unila.ac.id/index.php/jpp/

# Fostering Students' Creative Attitudes in Laboratory Inquiry Activities: Learning about Extraction by Utilizing Dragon Fruit Skins

**Sunyono[1,*] & Annisa Meristin[2]**

[*1]Doctoral Program in Education , Universitas Lampung, Indonesia

[2]Department of Chemical Education, Universitas Lampung, Indonesia

*Corresponding email: sunyono.1965@fkip.unila.ac.id

*Received: 08 April 2024* *Accepted: 13 May 2024* *Published: 15 May 2024*

**Abstract: Fostering Students' Creative Attitudes in Laboratory Inquiry Activities: Learning about Extraction by Utilizing Dragon Fruit Skins. Objective:** The current study aimed to determine the effect of the laboratory inquiry learning model on students' creative attitudes. **Methods:** This research was conducted using a pretest-posttest non-equivalent control group design and data analysis was carried out using descriptive statistical analysis n-Gain and t-test. Data collection techniques were carried out by means of observation and questionnaires. **Findings:** The results showed that there was a significant influence on the development of creative attitudes, especially on indicators of mutual respect. Strategy used in this research was successful in increasing students' activities in the classroom. **Conclusion:** Laboratory inquiry activities by utilizing dragon fruit skins can be used as a attractive learning strategy to improve students' creative attitude in learning about extraction.

**Keywords:** laboratory inquiry, creative attitude, learning about extraction.

***To cite this article:***

Sunyono, S., & Meristin, A. (2024). Fostering Students' Creative Attitudes in Laboratory Inquiry Activities: Learning about Extraction by Utilizing Dragon Fruit Skins. *Jurnal Pendidikan Progresif*, *14*(1), 440-450. doi: 10.23960/jpp.v14.i1.202432.

## INTRODUCTION

Education in the era of the Industrial Revolution 4.0 emphasizes the use of information technology in learning. This will help students to be able to learn independently. The ability of students to learn independently will produce creative and insightful individuals. Especially in science learning which has 3 aspects, namely process, product, and attitude (Ernawati, Muhammad, Asrial, & Muhaimin, 2019). However, the reality of various studies shows that the process of learning science in the classroom places more emphasis on product aspects. In addition, learning activities carried out in the classroom only use conventional learning and emphasize more on verbalistic learning, where the teacher is the center of information (Liliasari, 2007; Nentwig, Demuth, Parchmann, Ralle, & Gräsel, 2007; Holbrook & Rannikmae, 2009; Sunyono & Meristin, 2018). In fact, meaningful learning by involving students actively is an important factor so that learning can be said to be successful (Smith & Nakhleh, 2011). In addition, students must have mastery of new concepts and skills in order to be able to compete (Salam, Ibrahim & Sukardjo, 2019). Students must be able to explore new knowledge and not only repeat themselves to be able to solve problems (Mustofa & Hidayah, 2020). So that the three aspects of science learning will be carried out optimally. For that, we also need a learning model that is willing to support the learning process, one of which is the laboratory inquiry model.

Inquiry-based learning can stimulate students' curiosity so as to improve their ability

to ask questions, design hypotheses, and find relevant answers (Ruzaman & Rosli, 2020). Laboratory inquiry learning consists of students who independently construct and carry out experiments and collect accurate data that is analyzed to find the relationship of several variables (Wenning, 2005). Laboratory inquiry learning will eliminate the notion that the classroom and laboratory are separate parts (Sund & Trowbridge, 1973). So that students can integrate the knowledge they have received with actions in the laboratory or vice versa. In addition, laboratory inquiry supports students to apply their knowledge, understand real-world situations and support findings (Ketpichainarog, Panjipan & Ruenwongsa, 2010; Toth, Ludvico & Morrow, 2012; Nagl, Gledic & Djokic-Djovanovic, 2013; Buntern *et al*., 2014). Laboratory inquiry learning also helps educators to increase students' self-confidence and critical thinking skills (Wall, Dillon & Knowles, 2015; Verawati & Hikmawati, 2020). Several studies have been conducted by combining inquiry learning with several learning methods. Valentová and Breèka have combined inquiry learning with the AAA (Anotation-Analysis-Alternation) learning method to improve the quality of learning (Valentová & Breèka, 2020). In addition, Lam et al. has conducted a study on the use of learning innovations using Augmented Reality (AR) applications in inquiry learning (Lam et al. 2020). According to Lawson (1995), laboratory inquiry learning has several stages, namely: (1) exploring phenomena and formulating problems; (2) formulating hypotheses; (3) designing and implementing methods of hypothesis testing, (4) organizing and analyzing data; and (5) draw conclusions and communicate them.

To face challenges in the era of the Industrial Revolution 4.0, it also requires the development of student creativity. However, Jumadi *et al (2021)* explained that the creative thinking ability of students in Indonesia is still at a low level. The creative attitude plays an important role in building an individual's mentality in order to compete with society. Creative attitude is one of the criteria for creativity that is important for someone to survive and adapt. Creative attitude is related to other creativity criteria, where creative person will involve themselves in creative thinking. Creative thinking always involves personality and motivation factors, complex thinking activities and cognitive abilities, styles, strategies, and metacognitive skills so that they can reflect the personality of students who are considered unique individuals (Palupi, Subiyantoro, Triyanto & Rukayah, 2020). Furthermore, the existence of environmental factors will make a person take creative actions that ultimately produce creative products (Rhodes, 1961; Stojanova, 2010; Wiranata, 2019). In addition, the importance of creative attitudes in a person has been investigated by several researchers who show that several attitudes such as the willingness to solve problems, the willingness to take reasonable risks, the willingness to tolerate ambiguity, and self-efficacy are creative functions (Stenberg, 2006).

The characteristics of students who have a creative attitude are when they are able to deeply recognize basic knowledge and learn something new, open up new ideas, and look for material sources to develop ideas (Brookhart, 2010). According to William (in Munandar, 2012), indicators of creative attitudes include curiosity, being imaginative, feeling challenged by diversity, dare to take risks, and respect.

A creative attitude is one of the Graduate Competency Standards in the curriculum of Vocational High Schools in Indonesia. These creative attitudes include (1) being independent and responsible; (2) has the ability to interact and work in groups in a polite, effective and productive manner; (3) has the ability to adapt to the situation and work environment effectively; (4) have the curiosity to develop their skills; (5) realizing self potential and resilient; (6) has the ability to communicate; (7) has the ability to seek and generate ideas and ways of working together

to solve problems; (8) has the ability to appreciate, criticize, and apply aesthetic aspects; (9) and has the ability to calculate and take risks in managing a business (Regulation of the Minister of National Education Number 34 of 2018).

Students' creative attitudes can be developed through learning. For example, learning one of the Basic Competencies in the curriculum in Indonesia is separating various types of mixtures using certain separation techniques based on the characteristics of the mixture, as well as measuring an element or compound using certain measurement techniques (Ministry of Education and Culture, 2013). One technique that can be used for this separation is extraction. This basic competence is contained in the chemistry material at the 11$^{th}$ grade Vocational High School, majoring in food crop agribusiness.

In order for learning the topic of extraction to be meaningful to students, learning can be done by utilizing things around the environment. Extraction learning can be done by utilizing dragon fruit peel. Dragon fruit peel is soft and thick and contains large anthocyanins. The anthocyanin content in dragon fruit skin can be used as a dye. According to Winarno (1992) anthocyanins are a group of pigments ranging in color from red to blue which are soluble in water and are very widespread in flowers, skins and leaves.

Ramirez and Ganaden have conducted research on creative attitudes using laboratory inquiry models (Qing, Jing & Yan, 2010). They found that inquiry-based chemistry experiments and task-based learning in chemical experiments were able to increase students' creative activities. In addition, learning with laboratory inquiry through the theme of packaged drinks is proven to be able to develop student creativity (Sari, 2014). Meanwhile, according to Trnova (2014), learning that demands student activity, connects learning content with real life, asks open-ended questions and the use of technology and multimedia effectively affects student creativity. This study aims to develop the creative attitudes of vocational high school students through the use of dragon fruit peels using laboratory inquiry learning on the topic of extraction.

## METHOD

### Research method

This research was conducted by giving a treatment to the research subjects from the two selected classes and then observing them. The research design used a pretest-posttest non-equivalent control group design with a learning sequence as shown in Table 1.

**Table 1.** Research design

| Kelas | Pretest | Treatment | Posttest |
|---|---|---|---|
| Experiment | O1 | X | O2 |
| Control | O1 | Y | O2 |

Information:
O1 : Pretest experimental class and control class
O2 : Posttest experiment class and control class
X : Learning using laboratory inquiry
Y : Learning using conventional practicum

### Participants

The number of participants involved in this study were 164 students of grade 11 Vocational High School, Department of Food Crops Agribusiness, in Bandar Lampung City, Lampung Province, Indonesia. All participants were divided into two groups, namely the experimental class with 82 students and the control class with 82 students.

### Procedures and Data Analysis

The data collected in this study were data on students 'creative attitudes based on direct observation of the learning process and data on students' creative attitudes based on filling out questionnaires. The research instruments used to

collect data on creative attitudes in the form of observation sheets and questionnaires were all arranged according to the indicators of creative attitudes according to William (in Munandar, 2012) The creative attitude questionnaire compiled includes 20 statement items. Each item of the statement is given a score for each, namely: score for the answer ST (Very Correct) = 3, T (Exactly) = 2, TT (Not Correct) = 1.

### Content Validity of the Creative Attitude Questionnaire

The research instrument was a questionnaire which was validated by seven validators who are experts in their fields. This validity test involving experts is called the content validity test (Drost, 2011). The purpose of this validation is to assess the suitability of statements in the instrument with indicators of their achievement (Thoha, 1994). This test is based on the value of the content validity ratio (CVR) obtained (Senocak *et al.* 2013). The test results will be compared with the critical CVR value, where the critical CVR value for involving seven experts in the content validity test is 0.622 (Wilson, Pan & Schumsky, 2012). If the CVR value obtained from the processed data on the instrument validity test is below the critical CVR value, then the statement items in the questionnaire fall into the invalid category. And on the contrary, if the CVR value is above the critical CVR value, then the statement is included in the valid category.

### Reliability Test of Creative Attitude Questionnaire

The reliability of the questionnaire was determined based on the Cronbach's Alpha (á) value. Data processing was carried out using the SPSS program. And the reliability test results will be determined based on the classification of Cronbach's Alpha values from Gliem and Gliem (2003), namely very good (á> 0.9), good (0.8 <á d" 0.9), be accepted (0.7 <á d" 0, 8), questionable (0.6 <á d" 0.7), less (0.5 <á d" 0.6), and not acceptable (0.0 <á d" 0.5).

### Analysis of the Influence of Laboratory Inquiry Learning Models on Students' Creative Attitudes

Data analysis was carried out using quantitative and qualitative approaches. In quantitative analysis, n-Gain analysis was carried out to determine changes in attitude values during the pretest and posttest, both in the control group and the experimental group. In addition, to see the effect of laboratory inquiry learning, a statistical analysis was carried out using the T-test. The T-test can be used if all data groups are normally distributed, so that a normality test using the Kolmogorov-Smirnov test also needs to be done before the test.

Apart from quantitative analysis, qualitative descriptive analysis is also carried out to strengthen or support the results of the analysis using a quantitative approach. Qualitative descriptive analysis used in this study is intended to describe the data collected from a phenomenon that took place during learning or in the past (Wiersma & Jurs, 2009).

## ■ RESULT AND DISCUSSION

### Reliability Test of Creative Attitude Questionnaire

The validity of the content carried out aims to determine the suitability of the statements in the questionnaire with the achievement indicators. In this case, indicators of achievement are based on indicators of creative attitudes from Wiliam (Winarno, 1992), namely curiosity, imaginative nature, feeling challenged by diversity, dare to take risks, and respect. The test results show that the CVR value of each statement in the questionnaire has a value in the range 0.714 - 1,000. This means that the CVR value of all statements is above the critical CVR value (0.622). So it can be said that all statement items in the questionnaire fall into

the valid category, even though there are several statement items that need a little improvement. The valid category obtained also shows that the statements made in the questionnaire have a suitability to measure the achievement of indicators of creative attitudes in the learning process (Adeleke & Joshua, 2015).

**Questionnaire Reliability Test Results**

This test is carried out based on the acquisition of Cronbach's Alpha value. There are 20 statement items contained in the questionnaire. The results of the reliability test can be seen in Table 2. The data in Table 1 shows that the Cronbach's Alpha value is 0.912. If you refer to the Cronbach's Alpha value classification from Gliem and Gliem [39], then this value falls into the very high reliability category.

**Table 2.** Results of reliability analysis on multiple choice questions based on reasoning

| Cronbach's Alpha | N of Items |
|---|---|
| .912 | 20 |

The high Cronbach's Alpha value indicates that the questionnaire has good reliability and consistency when used as a measuring tool. This is because reliability is related to the determination of the test results of a measuring instrument, where the measuring instrument can give the same results if it is used on the same subject and conditions (Firman, 2000; Arikunto, 2008; Baehaki, Nahadi & Firman, 2016)). The greater and closer to the value 1, the reliability of a measuring instrument will be higher.

**Analysis of the Influence of Laboratory Inquiry Learning Models on Students' Creative Attitudes**

Assessment of students' creative skills on the topic of extraction using dragon fruit peel as a dye was carried out using a questionnaire and direct observation of attitudes during the learning process. The initial assessment and final assessment after treatment were carried out to the control group and the experimental group. Based on the initial and final assessments, there was an increase in students' creative attitudes. The improvement of students' creative attitudes based on the initial and final assessments can be seen in Figure 1.

Figure 1 shows that the average creative attitude of students after learning is higher than before learning in both the experimental class and the control class. Analysis of the N-Gain value showed that the N-Gain mean of students' creative attitudes in the experimental class was 0.73, while in the control group was 0.37. The N-Gain value in the experimental group was in the high category, while the N-Gain value in the control group was in the medium category. That is, learning using laboratory inquiry methods are more effective in improving students' creative attitudes. The results of this study are in line with Sari, Ratnasari, and Farida (2016) who reported that students' creative attitudes can be developed through practicum activities in learning with the Context Based Learning (CBL) model and the results are more effective than the creative attitudes of students whose learning is carried out conventionally. This is also in line with Manalu's research which concluded that the implementation of a cooperative model on thermodynamic material can train and improve students' creative attitudes (Manalu, Asmadi & Rasmiwetti, 2012). Thus, the results of this study complement the results of previous studies in an effort to improve students' creative attitudes through creative work and train higher-order thinking skills.

This increase in creative attitudes is also shown by direct observation data in the learning process using laboratory inquiry methods. Figure 2 shows the percentage value of students' creative attitudes during the learning process in the experimental class.

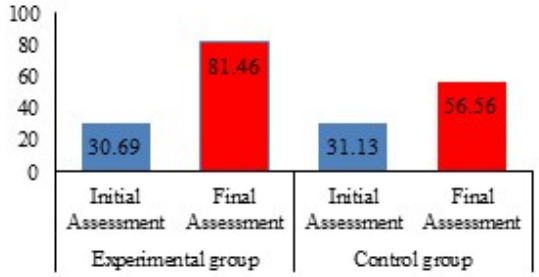


**Figure 1.** Average initial and final value

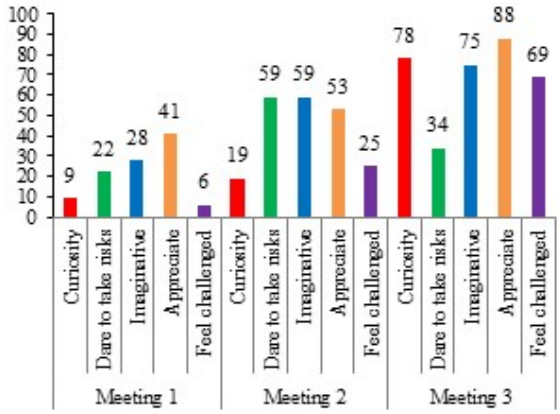


**Figure 2.** The percentage increase in students' creative attitudes in each experimental class meeting

Figure 2 provides information that in general the creative attitude of students at each meeting tends to increase. Except for the indicator "dare to take risks", which at the third meeting actually shows a lower percentage value compared to the second meeting. Of course this is an interesting thing to study in depth. The analysis based on direct observation was also carried out more thoroughly. The results of the analysis indicate that students still have difficulty defending ideas when making presentations and asking questions. This condition is allegedly because so far the ongoing learning process has not trained students to be able to argue and dare to ask questions. So that it becomes a habit and results in students lacking confidence in their own abilities. This is observed in almost all students during the learning process.

The largest increase in the percentage value occurred in the indicator of "Appreciate", both in the control group and the experimental group. Things that are observed regarding respect during the learning process include paying more attention to teacher explanations, following the rules in group discussions, and mentioning data sources when arguing. This significant increase occurred because of an increase in student enthusiasm for teaching materials using materials that had never been done before, namely using dragon fruit peel extract. This interest also turned out to be able to stimulate curiosity and bring up students' arguments during discussion sessions.

To see whether the application of this laboratory inquiry learning method had a significant effect, the T-test was carried out. Previously, the data normality test was carried out first as the main requirement when using the T-test. The normality test showed the sig value. is above 0.05 (sig.> 0.05), so it can be said that the data is normally distributed. Because the data is normally distributed, the T-test can be performed. Table 3 shows the results of data analysis using the T-test.

**Table 3.** T test results on n-Gain values using the independent sample T test

| Group | N | Average | *Df* | $T_{Calculation}$ | *P* |
|---|---|---|---|---|---|
| Experiment | 82 | 81.46 | 62 | 21.83 | 0.00 |
| Control | 82 | 56.56 | | | |

The data in Table 3 shows that the sig (2-tailed) value is 0.00 or sig <0.05. This value provides information that the n-Gain average of students 'creative attitudes in learning mixed separation material using laboratory inquiry is significantly different from the n-Gain average of students' creative attitudes who do conventional learning using practicum. These results illustrate that the implementation of learning the mixed separation concept using laboratory inquiry

models has an effect on improving students' creative attitudes in learning.

The increase in students' creative attitudes in this study occurred because the learning was carried out contextually, where the mixed separation material was taught to students by relating it to dragon fruit (*Hylocereus polyrhizus*) which was widely spread in the student environment. This is certainly a new thing that is interesting for them, so that it can stimulate curiosity in themselves. Dragon fruit is indeed one of Indonesia's natural resources and is found in various regions, especially in Lampung Province. Learning laboratory inquiry by utilizing dragon fruit as a medium for teaching mixed separation material can be done because dragon fruit contains anthocyanin dyes that can be used as natural dyes. According to the results of research by Sengkhamparn that dragon fruit peel contains high anthocyanins, pectins, and fiber (Sengkhamparn, Chanshotikul, Assawajitpukdee & Khamjae, 2013). Furthermore, it is stated that the anthocyanin substance can be obtained through a separation method, namely extraction. Therefore, this research was conducted by utilizing dragon fruit skin in the manufacture of natural food dyes in order to equip students 'abilities and train students' creative attitudes more effectively.

The next test is to determine the effect size of the implementation of learning in order to determine the size of the effect of the application of laboratory inquiry in learning the concept of mixture separation. The effect size is calculated using the t value from the T-test results from the pretest and posttest values. Therefore, each class, both the experimental class and the control class, is tested for its effect size. The analysis results are presented in Table 4.

**Table 4.** Effect size test results

| Group | Value | Average Score | *df* | T | $t^2$ | μ | Criteria |
|---|---|---|---|---|---|---|---|
| Experiment | Initial Assessment | 30.69 | 162 | -24.61 | 605.85 | 0.95 | Great influence |
| | Final Assessment | 81.46 | | | | | |
| Control | Initial Assessment | 31.13 | 162 | -12.01 | 144.46 | 0.84 | Great influence |
| | Final Assessment | 56.56 | | | | | |

Based on the data in Table 4, the increase in students 'high creative attitudes is 95.00% influenced by laboratory inquiry learning by utilizing dragon fruit as material for practicum activities, while in the control class the increase in students' creative attitudes is lower, namely 84.00%, influenced by conventional learning (without laboratory inquiry). Of course this shows a greater effect of laboratory inquiry-based learning by utilizing dragon fruit peel as a chemical practice material to increase students' creative attitudes. In addition, student involvement also makes the learning process more meaningful. Meaningful learning by involving students actively is an important factor so that learning can be said to be successful (Smith & Nakhleh, 2011). With active student involvement, three aspects of science learning will be fulfilled, namely processes, products, and attitudes. The results of this study are also relevant to research conducted by Putriana has concluded that learning with socio-scientific issues had a major effect on improving students' metacognitive abilities in electrolyte and non-electrolyte solution material (Putriana, Sunyono & Diawati, 2018). Furthermore, Furthermore, the research results of Agustin, Sunyono & Efkar (2019) have found that chemistry learning based on socio-scientific issues has a 'big' and 'positive' influence in improving students' creative attitude abilities on the topic of electrolyte and non-electrolyte solutions. Other research concludes that chemistry learning based on socio-scientific problems using household chemistry materials can increase students' learning activities in class which include asking questions, carrying out practicums, providing responses, and doing exercises (Sunyono & Efkar, 2020). Likewise, the results of research conducted by Sugiarti and Sunyono

(2021) have concluded that learning chemistry through practicums using household chemicals can increase students' interest and understanding of chemical concepts. Thus it can be said that the results of this study can be used as an alternative to learning chemistry in schools in an effort to increase students' knowledge and creativity.

## CONCLUSION

The learning model using the laboratory inquiry method on the extraction material was able to improve students' creative attitudes by increasing attitudes by 95%. The biggest increase occurred in the indicator "Appreciate". In addition, the use of dragon fruit peel extract media is able to provide a stimulus to increase students' curiosity. So that in the learning process, students become more active and meaningful. Thus, it can be said that the laboratory inquiry learning method using dragon fruit peel as a practical material on extraction can be used as an alternative method to improve students' creative attitudes.

## ACKNOWLEDGEMENTS

The authors are grateful to University of Lampung and Institut Kesehatan Rajawali, who were willing to cooperate in completing this research. The authors also want to thank all those who have helped both material and moral so that this research can be carried out well.

## REFERENCES

Adeleke, A. A., & Joshua, E. O. (2015). Development and validation of scientific literacy achievement test to assess senior secondary school students' literacy acquisition in physics. *Journal of Education and Practice*, *6*(7), 28–43. https://files.eric.ed. gov/fulltext/ EJ1083081.pdf.

Agustin, M. S., Sunyono, S., & Efkar, T. (2019). *Pengaruh isu sosio-saintifik dalam meningkatkan sikap kreatif siswa pada materi larutan elektrolit dan non-elektrolit*. *Jurnal Pendidikan dan Pembelajaran Kimia*, *8*(2), 283-294.

Arikunto, S. (2008). *Dasar-dasar evaluasi pendidikan (Edisi Revisi)*. Jakarta: PT. Bumi Aksara.

Baehaki F., Nahadi, dan Firman H. (2016). *Pengembangan dan validasi tes pilihan ganda berbasis penalaran untuk mengukur penguasaan materi kesetimbangan kimia*. Bandung: Universitas Pendidikan Indonesia. https:// repository.upi.edu/ 26421/.

Brookhart, S. M. (2010) How to assess higher-order thinking skills in your classroom. Virginia USA: Alexandria.

Bunterm, T., Lee, K., Ng Lan Kong, J., Srikoon, S., Vangpoomyai, P., Rattanavongsa, J., & Rachahoon, G. (2014). Do different levels of inquiry lead to different learning outcomes? A comparison between guided and structured inquiry. *International Journal of Science Education*, *36*(12), 1937-1959.

Drost, E. A. (2011). Validity and reliability in social science research. *Education Research and Perspectives*, *38*(1), 105–123. https:/ /www. researchgate.net/publication/ 261473819_Validity_and_Reliability_in_ Social_Science_Research.

Ernawati, M.D.W., Muhammad, D., Asrial, & Muhaimin. (2019). Identifying creative thinking skills in subject matter bio-chemistry. *International Journal of Evaluation and Research in Education (IJERE)*, *8*(4), 581-589. https://doi.org/ 10.11591/ ijere.v8i4.20257.

Firman, H. (2000). "*Penilaian hasil belajar dalam pengajaran kimia*", Bandung, PMIPA UPI.

Gliem, J. A., & Gliem, R. R. (2003). Calculating, interpreting, and reporting cronbach's alpha reliability coefficient for likert-type

scales. *Midwest Research to Practice Conference in Adult, Continuing, and Community Education*, 82–88.

Holbrook, J. & Rannikmae, M. (2009). The meaning of scientific literacy", *International Journal of Enviromental & Science Education*, *4*(3), 275-288. http://files.eric.ed.gov/fulltext/EJ884397.pdf.

Jumadi, J., Perdana, R., Hariad, M. H., Warsono, W., & Wahyudi, A. (2021). The Impact of Collaborative Model Assisted by Google Classroom to Improve Students' Creative Thinking Skills. *International Journal of Evaluation and Research in Education*, *10*(2), 396-403.

Ketpichainarog, W, Panjipan, B, & Ruenwongsa (2010). Enchanced learning of biotechnology students by an inquiry-based cellulase laboratory. *International Journal of Enviromental and Science Education*, *5*(2), 169-187. http://files.eric.ed.gov/ fulltext/EJ884417.pdf.

Lam, M. C., Tee, H. K., Nizam, S. S. M., Hashim, N. C., Suwadi, N. A., Tan, S. Y., ... & Liew, S. Y. (2020). Interactive augmented reality with natural action for chemistry experiment learning. *Tem Journal*, *9*(1).

Lawson, A. E. (1995). Science teaching and the development of thinking. Belmont CA: Wadsworth Publishing Company.

Liliasari (2007). Scientific concepts and generic science skills relationship in the 21st century science education. *The First International Seminar of Science Education*.

Manalu, L.F., Asmadi, M.N., & Rasmiwetti. (2012). *Penerapan model pembelajaran tipe stad untuk meningkatkan sikap kreatif siswa pada pokok bahasan termokimia di kelas xi ipa sman 3 pekanbaru*. Riau: Program Studi Pendidikan Kimia FKIP Universitas Riau.

Ministry of Education and Culture (2013). *Kurikulum 2013 (Kompetensi Dasar SMK/MK)*. Jakarta: Kemendikbud.

Munandar, S.C.U. (2012). *Pengembangan kreativitas anak berbakat*. Jakarta : Rineka Cipta.

Mustofa, R. F., & Hidayah, Y. R. (2020). The effect of problem-based learning on lateral thinking skills. *International Journal of Instruction*, 13(1), 463-474. https://doi.org/10.29333/ iji.2020.13130a

Nagl, M., Gledic, N., & Djokic-Djovanovic, J. (2013). Experiment is the Central Part of the Topic and Realized by IBSE Method. *TEM Journal*, 2(2), 204-206.

Nentwig, P. M., Demuth, R., Parchmann, I., Ralle, B., & Gräsel, C. (2007). Chemie im Kontext: Situating learning in relevant contexts while systematically developing basic chemical concepts", *Journal of Chemical Education*, *84*(9), 1439. https://doi.org/10.1021/ed084p1439.

Palupi, B., Subiyantoro, S., Triyanto, T., & Rukayah, R. (2020). Creative-thinking skills in explanatory writing skills viewed from learning behaviour: A mixed method case study. *International Journal of Emerging Technologies in Learning (IJET)*, *15*(1), 200-212.

Putriana, P., Sunyono, S., & Diawati, C. (2018). *Pengaruh penggunaan isu sosiosaintifik untuk meningkatkan kemampuan metakognisi siswa pada materi larutan elektrolit dan non-elektrolit. Jurnal Pendidikan dan Pembelajaran Kimia*, *7*(2), 1-12.

Qing, Z., Jing, G., & Yan, W. (2010). Promoting preservice teachers' critical thinking skills by inquiry-based chemical experiment, *Procedia-Social and Behavioral Sciences*, *2*(2), 4597-4603. https://

doi.org/10.1016/j.sbspro.2010.03.737.

Regulation of the Minister of National Education Number 34 of 2018 concerning National Standards for Vocational Secondary School / Madrasah Aliyah Vocational Education.

Rhodes, M. (1961). An analysis of creativity. *The Phi Delta Kappan*, *42*(7), 305-310. https://www.jstor.org/ stable/20342603.

Ruzaman, N. (2020). Inquiry-based education: Innovation in participatory inquiry paradigm. *International Journal of Emerging Technologies in Learning (iJET)*, *15*(10), 4-15. .

Salam, M., Ibrahim, N., & Sukardjo, M. (2019). Effects of instructional models and spatial intelligence on the mathematics learning outcomes after controlling for students' initial competency. *International Journal of Instruction*, *12*(3), 699-716. https:// doi.org/10.29333/iji.2019.12342a.

Sari, N.I. (2014). *Laporan Studi Pendahuluan*. Bandung: Sekolah Pascasarjana, Universitas Pendidikan Indonesia.

Sari, S., Ratnasari, R., & Farida, I. (2016). *Pengembangan sikap kreatif siswa pada praktikum penjernihan air. EduChemia (Jurnal Kimia dan Pendidikan)*, *1*(2), 124-136.

Sengkhamparn, N., Chanshotikul, N., Assawajitpukdee, C., & Khamjae, T. (2013). Effects of blanching and drying on fiber rich powder from pitaya (Hylocereus undatus) peel. *International Food Research Journal*, 20(4),1595-1600. http://www.ifrj.upm.edu.my/ 20%20(04)%202013/ 12%20IFRJ%2020%20(04)%202013% 20Nopaporn%20(484).pdf.

Senocak, E., Samarapungavan, A., Aksoy, P., & Tosun, C. (2013). A Study on development of an instrument to determine turkish kindergarten students' understandings of scientific concepts and scientific inquiry processes. Educational sciences: theory and practice, 13(4), 2217-2228.

Smith, K. C. & Nakhleh, M. B. (2011). University students' conceptions of bonding in melting and dissolving phenomena. *Chemistry Education Research and Practice*, *4*, 398–408. https://doi.org/ 10.1039/C1RP90048J.

Sugiarti, R., & Sunyono, S. (2021). Chemistry learning through practicum with household materials during the covid-19 pandemic. *Jurnal Pendidikan Progresif*, *11*(1), 129-138.

Sund & Trowbridge. (1973). Teaching Science by Inquiry in The Secondary School, Ohio, Charles E. Merril Publishing Co.

Sunyono & Efkar, T. (2020). *Desain pembelajaran kimia sma berbasis sosiosaintifik dalam meningkatkan kemampuan literasi kimia dan efikasi diri siswa.* Laporan Penelitian Skim Terapan BLU Unila 2020. LPPM Universitas Lampung.

Sunyono, S., & Meristin, A. (2018). The effect of multiple representation-based learning (mrl) to increase students' understanding of chemical bonding concepts. *Jurnal Pendidikan IPA Indonesia*, *7*(4), 399-406. https://doi.org/10.15294/ jpii.v7i4.16219.

Stenberg, R.J. (2006). The nature of creativity. *Creativity Research Journal*, 18(1), 87-98.

Stojanova, B. (2010). Development of creativity as a basic task of the modern educational system. *Proc. Soc. Behav. Sci, 2*, 3395-400. https://doi.org/ 10.1016/ j.sbspro.2010.03.522.

Thoha, M. C. (1994). *Teknik Evaluasi Pendidikan*. Jakarta: PT. Raja Grafindo Persada.

Toth, E.E, Ludvico, L.R, & Morrow, B.L. (2012). Blended inquiry with hands-on and virtual laboratories: the role of perceptual features during knowledge construction. *Interactive Learning Environment Journal*, 22(5), 614-630. https://doi.org/ 10.1080/10494820.2012. 693102.

Trnova, E. (2014) IBSE and Creativity Development. *Science Education International,* 25, 8-18. https:// files.eric.ed.gov/fulltext/EJ1022897.pdf.

Verawati, N.N.S.P. and Hikmawati (2020). The effectiveness of inquiry learning models intervened by reflective processes to promote critical thinking ability in terms of cognitive style. *International Journal of Emerging Technologies in Learning*, *15*(16), 212–220. https:// www.onlinejournals.org/ index.php/i-jet/ article/view/11487/6337.

Valentová, M. and Breèka, P. (2020). Ways of critical and creative thinking development in practical training through video-study. *TEM Journal*, *9*(1), 327-334. https:// doi.org/10.18421/ TEM91 45.

Wall, K.P., Dillon, R., & Knowles, M.K. (2015). Fluorescence quantum yield measurments of fluorescent proteins: a laboratory experiment for biochemistry or molecular biophysics laboratory course. *Biochemistry and Molecular Biology Education Journal*, *43*(1), 52-59. https:/ /doi.org/ 10.1002/bmb.20837.

Wiersma, W. & Jurs, G.S. (2009). Research methods in education : an introduction. Boston: Pearsin.

Wenning, C. J. (2005). Levels of inquiry: hierarchies of pedagogical practices and inquiry process. *Journal of Physics Teacher Education, 2*(3), 3-11. http:// www2.phy.ilstu.edu/pte/publications/ levels_of_inquiry.pdf.

Wilson, F., Pan, W., & Schumsky, D. (2012). Recalculation of the critical values for lawshe's content validity ratio. *Measurement and Evaluation in Counseling and Development*, *45*(3), 197–210. https://doi.org/ 10.1177%2F074817561244 0286.

Winarno (1992). *Kimia Pangan dan Gizi*. Jakarta: Gramedia.

Wiranata, R. R. S. (2019). *Tantangan, prospek dan peran pesantren dalam pendidikan karakter di era revolusi industri 4.0. Journal Al-Manar*, *8*(1), 61-92. https:// doi.org/10.36668/jal.v8i1.99.