

## Research Article

# Developing student worksheet based on iMindMap in animalia topic to train creative thinking ability



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### ABSTRACT

Creative thinking ability can be trained to students during learning process using suitable learning materials. The purpose of this study was to produce a valid and **practical student worksheet based on iMindmap in Animalia topic to train students' creative thinking ability**. This R & D referred to 4D model (define, design, develop, and disseminate) without disseminate phase. The validity of student worksheets was determined based on experts (material, education and media) assessment. Meanwhile, **the practicality was evaluated based on teachers' and students' responses; and the readability of the worksheet** decided based on Fry Graph. The data gained were analyzed descriptive-quantitatively. The research results revealed that the worksheet developed was declared as very valid (mode value: 4) and very practical based on **practitioners' responses (mode value: 4) and students' responses (the positive responses reached 90.45%)**. In addition, the readability test result was at level 10, which means that the worksheet was suitable for Grade 10. Hence, it can be concluded that the student worksheet based on iMindMap in Animalia topic can be used to train **students' creative thinking ability**.



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## INTRODUCTION

Creative thinking ability is an ability to make new precise combinations based on data, information, and new or existing elements (Munandar, 2012). There are four aspects or main components of creative thinking i.e. fluency, flexibility, originality, and elaboration (Puspitasari et al., 2019). Creative thinking skills are needed by students to be an individual who can solve problems, dare to take risks, and are motivated to keep learning. Maharani et al. (2015) opined that creative thinking skills are needed by the individual to solve problems in daily life.

One of the Curriculum 2013 materials for biology is Animalia. Animalia contained in Basic Competence 3.9, namely classifying animals into phyla based on body layers, body cavities, body symmetry, and reproduction. Furthermore, Basic Competence 4.9 also presents a comparative report on the complexity of animal body layers (diploblastic and triploblastic), body cavity, body symmetry, and reproduction. This subject

has a high level of complexity that makes students have difficulty in comprehending the materials independently without any effective learning activities (Adityarini, 2013). Nisa et al. (2016) reported that Animalia, which was delivered using lecturing method as well as discussion aided with PowerPoint slides and assignments have led the students to be less active. As the consequences, it impacted on less optimal learning outcomes.

Animalia topic is very complex, as many characteristics need to be distinguished. Hence, teachers need certain strategies to help students to understand the contents of the topic well. An alternative strategy, which is potentially developed is creating mind map. This can simultaneously involve students' brain. Constructing mind map enables students to map their minds and stimulates their thoughts in all directions as well as brings brilliant and creative ideas (Buzan, 2013). Yeong (2013) stated that mind map is an effective learning strategy. It is a good strategy to use in teaching and learning process (Liu et al., 2014) besides increasing student knowledge (Long & Carlson, 2011). Nevertheless, an appropriate material preparation (e.g. mind-map-based teaching materials) is necessary to support the use of mind mapping strategy.

There are several advantages will be achieved by utilizing mind-map based learning material. It is easy to learn, simple, practical, interesting, varied, motivates students to learn, and summarizes principles in comprehensive way (Arifa & Chamidah, 2011). The research by Long and Carlson (2011) revealed that the use of mind map method eases students to construct the previous information contained in the materials studied. Furthermore, mind mapping improves creative thinking skills as considerable as stimulates students to produce ideas (Buran & Filyukov, 2015; Malycha & Maier, 2017; Leeds et al., 2018). In the past, a mind map was made conventionally using colored pens/pencils in which the root must have at least three branches containing short keywords. However, recently, various softwares have been developed to facilitate the creation of mind maps, one of which is iMindMap (Septiaji, 2015).

Mind map-based learning can be done using software called iMindMap (Rachmani, 2011). iMindMap is able to develop creative and effective ideas which, in turn, helps students to receive new information in a fun way (Septiaji, 2015). According to Firman (2015) and Septiaji (2015), iMindMap is an application developed from mind map learning method. In other words, it is mind maps, which are packaged into program or software. Thus, iMindMap helps students in learning, compiling, and storing as much information as desired. Amalia et al. (2013) has conducted a research aimed at developing worksheet using iMindMap Application for Biological Subject called Structure of Animal Tissues and produced worksheet with decent categories. However, to date, there is no student worksheet made based on iMindMap especially in Animalia topic.

Based on the description of the problem above, it is necessary to conduct a research addresses the development of student worksheets based on iMindMap in Animalia material for 10th graders. The purpose of this study was to produce a valid and practical student worksheet based on iMindMap to train creative thinking skill.

## METHOD

This research was conducted from October 2019 to June 2020. The 4D model (define, design, develop, and disseminate) without disseminate phase was used to develop student worksheet. This research was carried out in the Biology Department of FMIPA UNESA. In addition, the limited trial of the worksheet involved 20 students of X graders using Google Classroom.

The student worksheet based on iMindMap developed was validated by three experts i.e. media, education, and material experts. The instrument used by validators covered five aspects (content, presentation, language, student worksheet conformity with mind maps, and worksheet objectives conformity **with students' creative thinking ability. The worksheet is valid if it meets its mode value  $\geq 3$ .**

Furthermore, the media practicality was measured based on responses obtained from practitioners (n= five teachers) from several schools and students. The worksheet readability was determined based on Fry Graph. Meanwhile, the instrument used to analyze the practicality of iMindMap-based worksheet developed was questionnaires for both teachers and students which were fulfilled by five teachers and 20 X graders. The responses were collected using Google Form. Student worksheet based on iMindMap was categorized as **practical if the teacher responses reach the mode value  $\geq 3$  and student responses positively reach  $\geq 61\%$ .**

The worksheet readability was determined using Fry Graph. The Fry Graph was constructed based on paragraphs analysis results done in three repetitions (beginning, middle, and end). The analysis was done by selecting 100 words regardless of the length of the paragraph. Fry Graph readability test results were obtained from the meeting point between the number of sentences and the number of syllables multiplied by 0.6. Thus the points placed in between 9-12 of Fry Graph axis. Based on the results, it can be concluded that the worksheet is readable for X graders.

RESULTS AND DISCUSSION

Defining stage (*define*)

This research has succeeded in developing a valid and practical student worksheet based on iMindMap for Animalia topic. The worksheet consisted of two parts for both students and teachers (as guidance for teachers) (Figure 1). The student worksheet consisted of three topics: worksheet 1 (Basic of Animalia Classification), worksheet 2 (Invertebrates), and worksheet 3 (Vertebrates).

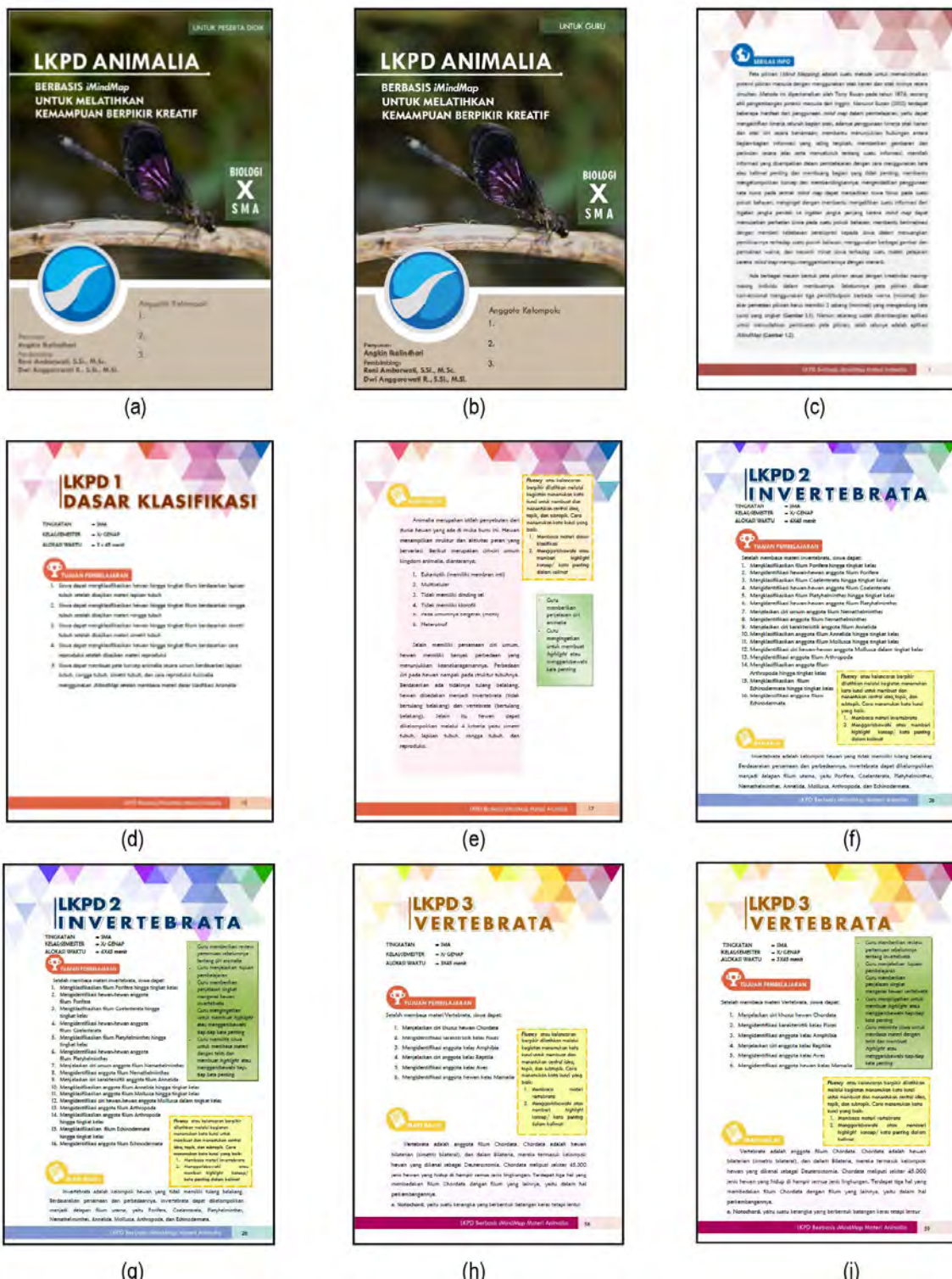


Figure 1. Profile student worksheet based on iMindMap Animalia material: (a) the main cover for student worksheet; (b) the main cover of worksheet for teacher; (c) information about mind map; (d) cover of student worksheet 1; (e) part of worksheet 1 for teacher; (f) cover of student worksheet 2; (g) cover of worksheet 2 for teacher; (h) cover of student worksheet 3 and (i) cover of worksheet 3 for teacher

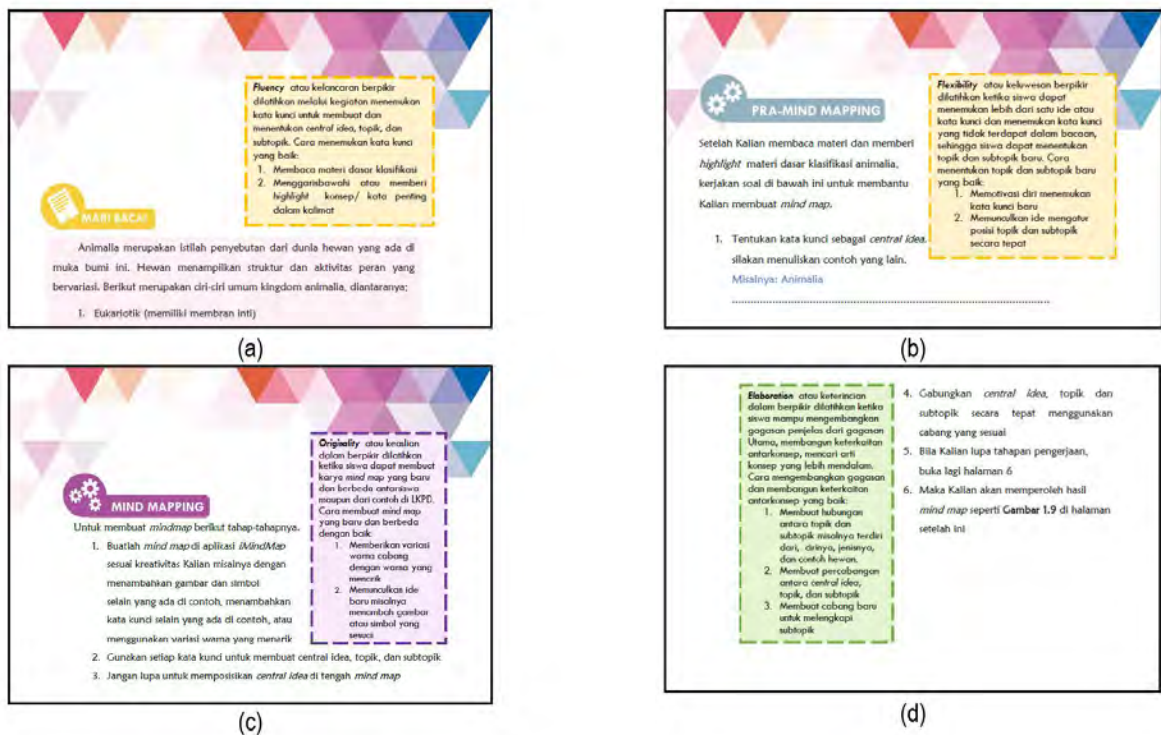

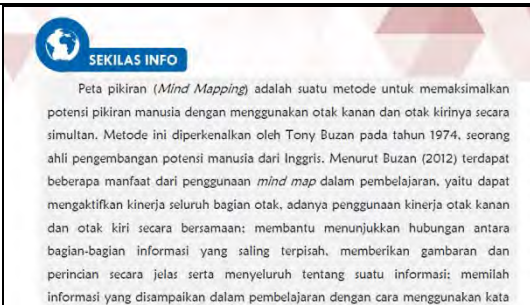

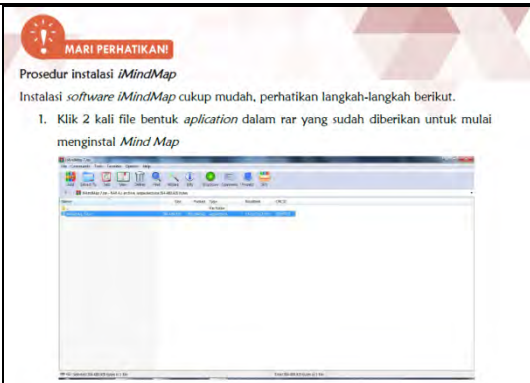





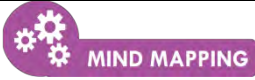
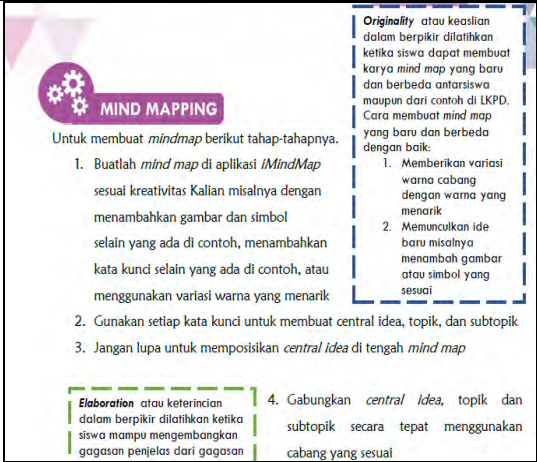
Figure 2. The features in student worksheet which trains creative thinking ability: (a) fluency; (b) flexibility; (c) originality; and (d) elaboration

In addition, the student worksheet is equipped with seven other features namely *Sekilas Info*, *Mari Perhatikan*, *Mari Kerjakan*, *Mari Berpikir*, *Mari Baca*, *Pra-Mind Mapping*, and *Mind Mapping* that have been adapted to four creative thinking ability indicators (Table 1).

Table 1. The features in student worksheet based on *iMindMap* in Animalia topic

| No | Features  | Previews   | Descriptions  |
|----|---|--|---|
| 1  |  |  | Giving information about <i>iMindMap</i> to increase student insights |
| 2  |  |  | Containing a guidance to make a <i>mind map</i> using <i>iMindMap</i> |

| No | Features  | Previews   | Descriptions  |
|----|---|--|---|
| 3  |    |  <p><b>Alat dan Bahan</b></p> <p>Alat:</p> <ol style="list-style-type: none"> <li>1. Alat Tulis</li> <li>2. Laptop</li> <li>3. Charger</li> <li>4. Aplikasi <i>iMindMap</i></li> </ol> <p>Bahan:</p> <ol style="list-style-type: none"> <li>1. LKPD untuk membuat peta pikiran menggunakan aplikasi <i>iMindMap</i></li> </ol> <p><b>Panduan membuat peta pikiran yang baik</b></p> <p>Sebelum membuat peta pikiran tentang dasar klasifikasi Animalia menggunakan aplikasi <i>iMindMap</i>, silakan perhatikan langkah-langkah di bawah ini:</p> <ol style="list-style-type: none"> <li>1. Membaca materi tentang dasar klasifikasi Animalia yang terdapat di LKPD 1</li> <li>2. Menggarisbawahi atau memberi <i>highlight</i> konsep/kata penting dalam kalimat</li> </ol>   | Facilitating students to start working on mind maps as well as practicing the fluency, flexibility, originality and elaboration   |
| 4  |    |  <p>Tuhan yang Maha Esa menciptakan berbagai makhluk hidup di muka bumi ini dengan berbagai bentuk, namun apakah kita pernah berpikir bagaimana cara mengelompokkannya? Amatilah berbagai jenis hewan yang ada di muka bumi ini.</p>  <p>Gambar 1.4 Animalia (Campbell et al., 2017)</p>   | Containing descriptions of earth real conditions aimed at preparing students to focus on a series of activities described in worksheet to train their creative thinking ability |
| 5  |  |  <p>2. Menggarisbawahi atau memberi <i>highlight</i> konsep/ kata penting dalam kalimat</p> <p>Animalia merupakan istilah penyebutan dari dunia hewan yang ada di muka bumi ini. Hewan menampilkan struktur dan aktivitas peran yang bervariasi. Berikut merupakan ciri-ciri umum kingdom animalia, diantaranya:</p> <ol style="list-style-type: none"> <li>1. Eukariotik (memiliki membran inti)</li> <li>2. Multiseluler</li> <li>3. Tidak memiliki dinding sel</li> <li>4. Tidak memiliki klorofil</li> <li>5. Pada umumnya bergerak (motil)</li> <li>6. Heterotrof</li> </ol> <p>Selain memiliki persamaan ciri umum, hewan memiliki banyak perbedaan yang menunjukkan keanekaragamannya. Perbedaan ciri pada hewan nampak pada struktur, tubanya, peredaran, ada tidaknya tulang</p>  | Facilitating students to read the material  |
| 6  |  |  <p>Setelah Kalian membaca materi dan memberi <i>highlight</i> materi dasar klasifikasi animalia, kerjakan soal di bawah ini untuk membantu Kalian membuat <i>mind map</i>.</p> <ol style="list-style-type: none"> <li>1. Tentukan kata kunci sebagai <i>central idea</i>.<br/>silakan menuliskan contoh yang lain.<br/>Misalnya: Animalia<br/>.....</li> <li>2. Tentukan topik dari materi ini. Di bawah ini diberi satu contoh, silakan menuliskan contoh yang lain.<br/>Misalnya: ciri animalia<br/>.....</li> <li>3. Jelaskan subtopik sebagai kata kunci penjelas secara singkat. Di bawah ini diberi dua contoh, silakan menuliskan contoh yang lain.<br/>Misalnya:<br/>.....</li> </ol> <p><b>Flexibility</b> atau keluwesan berpikir dilatihkan ketika siswa dapat menemukan lebih dari satu ide atau kata kunci dan menemukan kata kunci yang tidak terdapat dalam bacaan, sehingga siswa dapat menentukan topik dan subtopik baru. Cara menentukan topik dan subtopik baru yang baik:</p> <ol style="list-style-type: none"> <li>1. Memotivasi diri menemukan kata kunci baru</li> <li>2. Memunculkan ide mengahar postif topik dan subtopik secara tepat</li> </ol> | Helping students to find the keywords used in making mind maps  |

| No | Features  | Previews   | Descriptions   |
|----|---|--|--|
| 7  |  |  <p><b>Originality</b> atau keaslian dalam berpikir dilatihkan ketika siswa dapat membuat karya <i>mind map</i> yang baru dan berbeda antarsiswa maupun dari contoh di LKPD. Cara membuat <i>mind map</i> yang baru dan berbeda dengan baik:</p> <ol style="list-style-type: none"> <li>1. Memberikan variasi warna cabang dengan warna yang menarik</li> <li>2. Memunculkan ide baru misalnya menambah gambar atau simbol yang sesuai</li> </ol> <p><b>Elaboration</b> atau keterincian dalam berpikir dilatihkan ketika siswa mampu mengembangkan gagasan penjelas dari gagasan</p> <ol style="list-style-type: none"> <li>4. Gabungkan <i>central idea</i>, topik dan subtopik secara tepat menggunakan cabang yang sesuai</li> </ol> | Helping students to create a mind map based on the keywords obtained |

The results of validity assessment of student worksheet by three validators showed that the student worksheet developed achieved 4 in term of mode value. In the other words, it is categorized as very valid (Table 2).

Table 2. Recapitulation of student worksheet validation results

| No   | Aspect  | Score of Validation |    |    | Mode Value |
|--|---|---------------------|----|----|------------|
|  |   | V1                  | V2 | V3 |            |
| Presentation Feasibility   |   |                     |    |    |            |
| 1  | Display Quality   | 4                   | 4  | 3  | 4          |
| 2  | Layout Quality  | 4                   | 4  | 4  |            |
| 3  | Text Accuracy   | 3                   | 4  | 4  |            |
| 4  | Image Quality   | 3                   | 4  | 4  |            |
| 5  | Time Allocation   | 4                   | 4  | 4  |            |
| 6  | Learning Objectives   | 4                   | 4  | 4  |            |
| 7  | Instructions for Use of Student Worksheets                        | 4                   | 4  | 4  |            |
| Category Mode  |   |                     |    |    | Very Valid |
| Content Feasibility  |   |                     |    |    |            |
| 8  | Quality of Material Concepts                                      | 4                   | 4  | 4  | 4          |
| 9  | Suitability of Student Worksheet to the students                  | 4                   | 4  | 4  |            |
| 10   | Material Content  | 4                   | 4  | 4  |            |
| Category Mode  |   |                     |    |    | Very Valid |
| Linguistic Feasibility   |   |                     |    |    |            |
| 11   | Language  | 4                   | 4  | 4  | 4          |
| 12   | Sentence  | 4                   | 4  | 4  |            |
| Category Mode  |   |                     |    |    | Very Valid |
| Suitability of Student Worksheets for iMindMap use               |   |                     |    |    |            |
| 13   | Use of Applications   | 4                   | 4  | 4  | 4          |
| 14   | Making a Mind Map   | 4                   | 4  | 4  |            |
| 15   | Examples of Mind Map Appropriate Character Mind Map               | 3                   | 4  | 4  |            |
| 16   | Examples of Mind Maps Appropriate Indicators of Creative Thinking | 4                   | 4  | 4  |            |
| Category Mode  |   |                     |    |    | Very Valid |
| Achievement of Purpose in Practicing Creative Thinking Abilities |   |                     |    |    |            |
| 17   | Practicing Fluency in Thinking (Fluency)                          | 4                   | 4  | 4  | 4          |
| 18   | Practicing Flexibility in Thinking (Flexibility)                  | 4                   | 4  | 4  |            |
| 19   | Practicing Authenticity in Thinking (Originality)                 | 4                   | 4  | 4  |            |
| 20   | Practicing Detail in Thinking (Elaboration)                       | 4                   | 4  | 4  |            |
| Category Mode  |   |                     |    |    | Very Valid |
| Overall Mode   |   |                     |    |    | Very Valid |

Note: V1: material expert; V2: media expert; and V3: education expert

The assessment results done by teachers as practitioners, it was clear that the student worksheet developed was practical as the 4 score gained. This score is recognized to be very practical category (Table 3). To be more detail, the teachers also gave their feedbacks about the worksheet as follow.

*"At a glance, the information is too long and it is better to be shorten or change the feature Let's Read"; "iMindMap is in accordance with the characteristics of classification learning material, but it takes time, it is recommended to give an option for students to create a mind map which covers only five phyla"; "The time allocated is less appropriate, it needs to be reconsidered"; "The worksheet is good and cool. Yet, somehow, it needs to add different color backgrounds to the note features of creative thinking ability"; "The material consistency needs to be considered, especially on the origin of the phylum name. Furthermore, the Worksheet 3 should be revised. It must be two superclass i.e. Pisces and Tetrapoda"*

Table 3. Recapitulation of teachers' assessment on the student worksheet

| No   | Aspect  | Score |    |    |    |            | Mode Value |
|--|---|-------|----|----|----|------------|------------|
|  |   | T1    | T2 | T3 | T4 | T5         |            |
| Presentation Feasibility                                     |   |       |    |    |    |            |            |
| 1  | Display Quality   | 4     | 4  | 4  | 4  | 4          | 4          |
| 2  | Layout Quality  | 4     | 4  | 4  | 4  | 4          |            |
| 3  | Text Accuracy   | 3     | 4  | 4  | 4  | 4          |            |
| 4  | Image Quality   | 3     | 4  | 4  | 3  | 4          |            |
| 5  | Time Allocation   | 4     | 4  | 4  | 3  | 3          |            |
| 6  | Learning Objectives   | 4     | 4  | 4  | 4  | 4          |            |
| 7  | Instructions for Use of Student Worksheets                        | 4     | 4  | 4  | 4  | 4          |            |
| Category Mode  |   |       |    |    |    | Very Valid |            |
| Content Feasibility  |   |       |    |    |    |            |            |
| 8  | Quality of Material Concepts                                      | 4     | 4  | 4  | 4  | 4          | 4          |
| 9  | Worksheet Suitability for Students                                | 4     | 4  | 4  | 4  | 4          |            |
| 10   | Material Content  | 4     | 4  | 4  | 4  | 4          |            |
| Category Mode  |   |       |    |    |    | Very Valid |            |
| Linguistic Feasibility                                       |   |       |    |    |    |            |            |
| 11   | Language  | 4     | 4  | 4  | 4  | 4          | 4          |
| 12   | Sentence  | 4     | 4  | 4  | 4  | 4          |            |
| Category Mode  |   |       |    |    |    | Very Valid |            |
| Suitability of Student Worksheet to iMindMap                 |   |       |    |    |    |            |            |
| 13   | Use of Applications   | 4     | 4  | 4  | 4  | 4          | 4          |
| 14   | Making a Mind Map   | 4     | 4  | 4  | 4  | 4          |            |
| 15   | Examples of Mind Map Appropriate Character Mind Map               | 3     | 4  | 4  | 4  | 4          |            |
| 16   | Examples of Mind Maps Appropriate Indicators of Creative Thinking | 4     | 4  | 4  | 4  | 4          |            |
| Category Mode  |   |       |    |    |    | Very Valid |            |
| Activity Achievement of Creative Thinking Ability Objectives |   |       |    |    |    |            |            |
| 17   | Practicing Fluency in Thinking (Fluency)                          | 4     | 4  | 4  | 4  | 4          | 4          |
| 18   | Practicing Flexibility in Thinking (Flexibility)                  | 4     | 4  | 4  | 4  | 3          |            |
| 19   | Practicing Authenticity in Thinking (Originality)                 | 4     | 4  | 4  | 4  | 4          |            |
| 20   | Practicing Detail in Thinking (Elaboration)                       | 4     | 4  | 4  | 4  | 3          |            |
| Category Mode  |   |       |    |    |    | Very Valid |            |
| Overall Mode   |   |       |    |    |    | Very Valid |            |

Note: T1: Teacher 1; T2: Teacher 2; T3: Teacher 3; T4: Teacher 4; and T5: Teacher 5

Based on the results of the student responses gained through questionnaire, in general, students gave a positive response to the student worksheet. It was shown by the average of positive response percentage which reached as high as 90.45%. This means that the worksheet developed is very practical (Table 4). The students also delivered comments and suggestions for the worksheet. Some of which stated

*"iMindMap-based worksheet of Animalia material is very interesting and easy to understand"; "The worksheet is good and cool"; "The worksheet is easy to read"; "The worksheet can support students to train their ability to think creatively through sentences that are easily understood"; "The worksheet helps students to produce original work, able to think fast, and suitable for learning activities"*.

Table 4. Recapitulation of student responses to the student worksheets

| No   | Aspect   | Percentage of Positive Responses (%) | Category       |
|--|--|--------------------------------------|----------------|
| <b>A. Criteria for Presentation of Content</b>                                 |  |                                      |                |
| 1  | Animalia material is related to daily life   | 100                                  | Very Practical |
| 2  | iMindMap-based worksheet supports the implementation of student-centered learning                                    | 95                                   | Very Practical |
| 3  | The worksheet helps students work in groups  | 75                                   | Practical      |
| 4  | The worksheet helps to develop students' thinking processes  | 100                                  | Very Practical |
| 5  | The worksheet helps students understanding the concept of the material taught  | 80                                   | Very Practical |
| 6  | The worksheet attracts students' interest to learn   | 90                                   | Very Practical |
|  | Average  | 90                                   | Very Practical |
| <b>B. Criteria for Physical Presentation</b>                                   |  |                                      |                |
| 7  | The appearance of the worksheet is interesting   | 100                                  | Very Practical |
| 8  | The presentation of the worksheet attracts students' interest and attention to read                                  | 90                                   | Very Practical |
| 9  | The features in the worksheet are interesting  | 100                                  | Very Practical |
| 10   | The pictures on the worksheet support students' understanding of Animalia material                                   | 90                                   | Very Practical |
| 11   | The letters used in the worksheet are legible so it is comfortable to read   | 75                                   | Practical      |
|  | Average  | 91                                   | Very Practical |
| <b>C. Language Criteria</b>  |  |                                      |                |
| 12   | The language used is easy to understand  | 90                                   | Very Practical |
| 13   | The sentences used are easy to understand  | 95                                   | Very Practical |
| 14   | The terms used are easy to understand  | 90                                   | Very Practical |
|  | Average  | 91.6                                 | Very Practical |
| <b>D. Criteria of Student Worksheet Based on iMindMap</b>                      |  |                                      |                |
| 15   | The activity of making mind maps using the iMindMap application in the worksheet is interesting                      | 95                                   | Very Practical |
| 16   | Mind maps in the worksheet guides students to understand the concept of Animalia material                            | 90                                   | Very Practical |
| 17   | Making a mind map using the iMindMap application in the worksheet is easy to do                                      | 85                                   | Very Practical |
| 18   | Making a mind map using the iMindMap application in the worksheet makes students more active in organizing a concept | 85                                   | Very Practical |
|  | Average  | 88.75                                | Very Practical |
| <b>E. Student Worksheets for Practicing Creative Thinking Ability Criteria</b> |  |                                      |                |
| 19   | Making mind maps in the worksheet helps students to practice their flexible thinking skills                          | 90                                   | Very Practical |
| 20   | Making mind maps in the worksheet helps students to practice their ability to think smoothly                         | 85                                   | Very Practical |
| 21   | Making mind maps in the worksheet helps students to practice their ability to build linkages between concepts        | 100                                  | Very Practical |
| 22   | Activities in this worksheet help students produce original work   | 90                                   | Very Practical |
|  | Average  | 91.25                                | Very Practical |
|  | Overall Percentage   | 90.45                                | Very Practical |

The readability of iMindMap-based worksheet was measured using the Fry Graph. The results of the analysis are presented in Table 5.

Table 5. The results of student worksheet readability test using Fry Graph

| Sample | Page    | Number of Sentences | Number of Syllables x 0.6 |
|--------|---------|---------------------|---------------------------|
| Early  | 2       | 7                   | 287 x 0.6 = 172.2         |
| Middle | 38      | 9                   | 265 x 0.6 = 159           |
| End    | 72      | 6                   | 250 x 0.6 = 150           |
|        | Average | 7.3                 | 160.4                     |



Table 5 presents the analysis results of student worksheet. It can be obviously seen the number of sentences and syllables of the three parts of the worksheet. These data are used to determine the position of cutting point on Fry Graph (see Figure 3). This point, in the same time, represents the readability level of the student worksheet. Figure 3 depicts that the readability level of the student worksheet developed is 10.

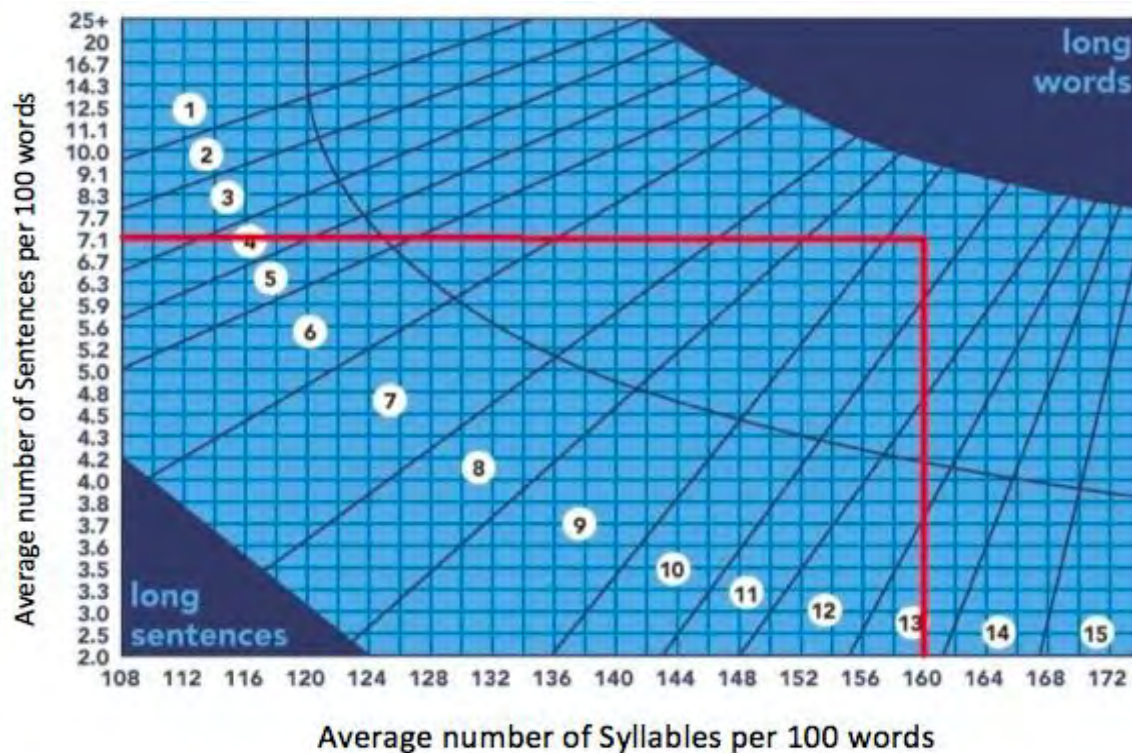


Figure 3. The readability test results of student worksheet using Fry Graph

Based on the validation results described on Table 2, the student worksheet developed was considered as very valid as the mode value gained was 4. This indicated that the student worksheet which was developed according to the requirements of the student worksheet and worthy to be used in learning. It was supported by the practitioner response which stated that student worksheet based on *iMindMap* was great and has a good design. The student worksheet was recognized as very valid. This makes sense as the developing process was conducted properly which covered five phases i.e. curriculum analysis, concept analysis, student analysis, assignment analysis, and followed by revision and improvement. This is supported by the statement of Fatmawati (2016) that a gradual and continuous development process in terms of train and revision are required to produce high quality product.

The validity of the student worksheet assessment developed consists of five aspects. The presentation feasibility aspect obtained a rating of mode 4 in a very valid category. This indicates that the student worksheet developed is attractive to use. The attractiveness exists as the worksheet covers several components in terms of quality of view and layout, precision of text, picture quality, location of time, the purpose of learning, and appropriate usage guidelines that qualify for the composition of student worksheet (Figure 1). A good student worksheet should meet several criteria, namely, a good writing, suitable picture, and interesting color to hook students' interest to study (Mazidah et al., 2019).

The material gained mode value of 4, which was categorized as very valid. In the other words, the student worksheet is able to facilitate students to improve their academic ability with suitable material content. Thus, the learners can easily understand the Animalia material. This is in line with previous researches, which reported that the use of student worksheet in learning process helps students understand their own material (Susantini et al., 2016). Furthermore, acknowledging the high complexity of Animal materials, Adityarini et al. (2013) and Nisa et al. (2016) argued that students need to be facilitated with effective learning. Notwithstanding that the worksheet achieved very valid category, there were also teacher comments which suggested that the material content must be suited with the latest version of biology textbook. To more specific, the classification of vertebrates contained in worksheet 3. It supposed to be composed of two superclass i.e. Pisces and tetrapoda.

The validation results showed that the student worksheet based on *iMindMap* obtained validation score 4. There were two linguistic components used: the use of language and sentence structure. The results

indicated that the language used has been consistent with perfected spelling based on EYD (*Ejaan Yang Disempurnakan*). This means that the terms used have reached learners' thinking level and do not give bias meaning. Moreover, the sentence structure used is clear and simple. It does not create a double meaning. This gives positive sign as Prastowo (2015) said that student worksheet with easily-understood language eases students to understand material as considerable as motivates them to learn. In addition to language, proper selections of font type and size need to be made to help students to read and concentrate easily (Ramadhani & Mahardika, 2015)

The suitability aspect for the using of *iMindMap* obtained mode value of 4 with the very valid category. This maximal score gained because the worksheet has been presented with detail information on the use of *iMindMap* application; the procedure of mind map creation and contains pre-mind mapping questions to help the learners to find key words. This in line with validator comment which stated that the student worksheet was great and contained of pre-mind mapping. Answering pre-mind mapping question after students have carefully read the material summaries makes students easier to construct mind mapping.

Besides the good comments, some constructive suggestions were also given by validator. One of which suggested that the mind map needs to be fixed as one of its parts was absent of images. Yet, the other parts were in properly arranged. The central idea was in the middle, the keywords have been linked to branches with keywords. Furthermore, the student worksheet contained of mind map, which meets all four indicators of creative thinking. The fluency was supported by correct keywords, which matched to the correct theory. The flexibility was also strengthened by topics positioning and subtopics proportionate. The originality was also supported by the use of various colors or images. The elaboration was done by linking the mind map with the fusion and consistent theories. *iMindMap* was developed based on mind map learning method (Firman, 2015) which is the easiest way to create a mind map by placing information into the brain and retrieving that information (Septiaji, 2015).

The fifth aspect of the validation was Activity Achievement of Creative Thinking Ability Objective. This aspect achieved 4 mode value (very valid category) as served in Table 2. There were four creative thinking indicators measured, namely, fluency, flexibility, originality, and elaboration (Figure 2). The previous research done by Kulsum (2017) reported that the application of the mind mapping learning model has increased student creativity and improved student achievement. In accordance with this research, Taadi et al. (2019) proved that the use of *iMindMap* application to construct mind map has enhanced students' creative thinking ability and concept boosting.

Besides obtaining very valid value, the validation procedure also covered feedbacks from validators in order to generate a highly qualified student worksheet. One of the validator's suggestions and input was as follow.

*"To ease students' understanding, the term used must be consistent whether it is mind map, concept map, or mind map. Genus spelling must be consistent. Picture legends suggested to be written in Bahasa Indonesia. Learning purposes must be improved. Additional features for student activity information in each creative thinking indicator are needed. Some symbols, photos, and pictures need to be added to the mind map in student worksheet for teacher."*

Based on the suggestions given by validators, the student worksheet was revised. Thus, the worksheet functions optimally.

Acknowledging that the mode value achieved from both teachers and practitioners was 4, the student worksheet was stated could be practically used in learning (Table 3). This in line with the validation results given by experts in which the mode value was 4 (Table 2).

The practicality of the student worksheet was measured based on student responses. The data resulted from questionnaire which was fulfilled by 20 students and analyzed showed the average value of positive response as high as 90.45% (see Table 4). This proved that the student worksheet content has met criteria determined. In the other words, the Animalia material has related to daily life aspect, the worksheet has facilitated student-centered learning, helped students working in their group, as considerable as helped student thinking development.

The physical presentation of the student worksheet was interesting, attracted students' interest and attention to read. It has interesting features and the pictures have promoted students' understanding about Animalia material. Combination of proper pictures and colors contained in the worksheet enables students to easily comprehend the materials learnt. This also helps students to concentrate in conducting learning processes in fun way (Buzan, 2013). Meanwhile, the language criteria was fulfilled as it is easily understood in terms of language, sentences, and technical terms. Widjajanti (2008) opined that to produce a good language which easy understood by readers, it must be matched with learners' thinking level, the sentences supposed to be brief, clear, simple, and have no bias meaning.

Positive responses were also given by learners to the student worksheet *iMindMap*. Point D contained in Table 4 showed that the student worksheet facilitated learners to create mind map using *iMindMap* application in an interesting and easy ways. Even though Animalia has been considered as complex material as it requires an organization of individual animal differences and similarities (Adityarini et al., 2013), yet the worksheet developed has been proven is able to stimulate learners to be more active in learning processes. Supriadi (2016) stated that mind mapping is a learning method that can improve student understanding. Long and Carlson (2011) said that the use of mind mapping method has helped student to determine the connection of the materials learnt. Moreover, Wheeldon (2011) proved that the respondents who used mind mapping method were able to remember, handle, and conduct reflection of their previous experiences.

The last point assessed from the student worksheet developed was the potential of the worksheet to train students' creative thinking skill (Point E of Table 4). The results show that the student worksheet has met the indicator of creative thinking training activity. This is crucial to be achieved by the worksheet as creative thinking is one of the main skills must be conquered in the 21<sup>st</sup> century (Zubaidah et al., 2017). The students opined that the worksheet is able to train their creative thinking skill as the all creative thinking aspects are fulfilled through mind mapping activities such as determining various central idea form using pictures, finding new keywords, find ideas to set the positions of topic and subtopic proportionally based on pre-mind mapping. Answering pre-mind mapping after reading material carefully eases students in generating mind map. Not only **does the worksheet train students' creative thinking skill, but it also trains their ability in connecting concepts** by determining branches among topic and subtopic. These branches function to connect keywords, thus, to look back the previous information obtained is easier (Liu et al., 2014) and **students' understanding will be fostered**.

Furthermore, students' original thinking was also trained by using the student worksheet. This was proven through the activity of expressing the idea in making variation of branch color, and add suitable picture to keywords. Devi et al. (2015) and Buzan (2013) said that the use of various colors makes mind map is more interesting, amusing, and stimulates students' creativity. The mind map produced by students, somehow, represents their creativity. Thus, each product possesses different characteristic.

The lowest percentage of students' positive response about the developed student worksheet was on its potential in aiding students to work in a group (75%). This means that there was a number of students who felt that the worksheet was not good enough to guide them to work together with their friends. The same response value given by students was worksheet readability (75%) which were followed by its potential in facilitating student to achieve their understanding (80%). Yet, this results were still in practical and very practical categories. Taadi et al. (2019) stated that Mind Mapping is an effective learning method to increase students' understanding. Meanwhile, the low percentage of worksheet readability was assumed because of font size of letters used in the worksheet. This led the students felt hard to read. This has been confirmed by the findings of many small font size (11) used in picture descriptions. Moreover, the keywords used in mind map examples were suited to their characteristics (e.g. its position from central idea). Thus, the farther the position from central idea, the smaller the font size will be.

On the other hand, the result of readability test reached level 10 (Figure 3). This test is crucial to be done to ensure the level of difficulty of the text to be read. Widyaningsih & Zuchdi (2015) stated that readability is the level of the hardest and the easiest of certain text to be understood by readers. Hence, readability is also suitable to readers' ability. The suitability of readability to users is the important aspect. This aspect determines student understanding about the content of their reading material (Khaldum, 2016). This means that the readability level results of the worksheet developed is suitable to the targeted users in term of X graders of senior high school.

Eventually, several advantages gained by generating *iMindMap*-based student worksheet are introducing interesting software in term of *iMindMap* and easy to help students in doing and training their creative thinking through constructing mind map. Taadi et al. (2019) reported that the use of mind map method using *iMindMap* gives positive effect to student creativity and their concept understanding. This also in line with the opinion given by **one of the teacher as a practitioner**, "*This student worksheet is very good and it can support student learning process as well as introduce iMindMap to students as the new application which facilitates their creativity.*" Hence, learning process becomes more amusing and the concept learnt will be strongly embedded. Moreover, the content and the material served in the worksheet are written in high quality as considerable as the language and the clue used are easily understood. One of students has responded, "*This student worksheet is very helpful for me to think more creative. Because students are demanded to make original creation, think quickly. I think, this worksheet is also suitable to Animalia material.*" The use of mind mapping method gives a good effect on students' affective such as creativity (Taadi et al., 2019). This method was also proven to be able to increase creative thinking skill in term of producing the newest idea (Buran & Filyujov, 2015; Malycha & Maier, 2017; Leeds e al., 2018).

## CONCLUSION

Student Worksheet based on iMindMap in Animalia Material is very valid based on the presentation of appropriateness criteria, language content, the compatibility to iMindmap, and the compatibility to creative thinking ability indicators. In addition, the student worksheet is very practical based on the responses of teachers as practitioners as considerable as students' and the readability test results. iMindMap software is interesting for students to construct mind map which stimulates them to think creatively.

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## REFERENCES

- Adityarani Y, Waluyo J, & Aprilya S. (2013). Penerapan model pembelajaran *Quantum Learning* dengan media *Flashcard* untuk meningkatkan motivasi dan hasil belajar siswa kelas X di SMA Negeri 1 Purwoharjo-Banyuwangi tahun pelajaran 2011/2012 (pokok bahasan Animalia). *Pancaran Pendidikan*, 2(2), 189-199. Retrieved from <https://jurnal.unej.ac.id/index.php/pancaran/article/view/695>
- Amalia, A. R., Susantini, E., & Budijastuti, W. (2013). Pengembangan Lembar Kerja Siswa (LKS) berbahasa Inggris yang berorientasi pemetaan pikiran menggunakan aplikasi iMindMap pada materi Struktur Jaringan Hewan. *Jurnal Berkala Ilmiah Pendidikan Biologi (BioEdu)*, 2(1), 1-5. Retrieved from <https://jurnalmahasiswa.unesa.ac.id/index.php/bioedu/article/view/1525>
- Arifa, Z., & Chamidah, D. (2011). Pengembangan bahan ajar Qawaid Bahasa Arab berbasis *Mind Map* untuk tingkat perguruan tinggi. *Jurnal El-Qudwah*, 4. Retrieved from <http://ejournal.uin-malang.ac.id/index.php/lemlit/article/view/1947>
- Buran, A. & Filyukov, A. (2015). Mind Mapping Technique in language learning. *XV International Conference "Linguistic and Cultural Studies: Traditions and Innovations"*, 206, 215-218. doi: <https://doi.org/10.1016/j.sbspro.2015.10.010>
- Buzan, T. (2013). Buku pintar mind map. Jakarta: PT. Gramedia Pustaka Utama
- Devi, R. S., Yuliaratiningsih, M. S., & Mulyati, T. (2015). Efektivitas Metode Mind Mapping terhadap peningkatan pemahaman konsep siswa pada Mata Pelajaran IPA. *Jurnal Antologi UPI*, 3(2), 1-8. Retrieved from <https://adoc.tips/efektivitas-metode-mind-mapping-terhadap-peningkatan-pemahaman.html>
- Fatmawati, A. (2016). Pengembangan perangkat pembelajaran konsep Konsep Pencemaran Lingkungan menggunakan model pembelajaran berdasarkan masalah untuk SMA Kelas X. *EduSains*, 4(2), 94-103. doi: <https://doi.org/10.23971/eds.v4i2.512>
- Firman, A. (2015). Pengembangan media pembelajaran *iMindMap* terhadap hasil belajar siswa pada Mata Pelajaran Teknik Elektronika Dasar di SMK Negeri 2 Bojonegoro. *Jurnal Pendidikan Teknik Elektro*, 4(1), 11-15. Retrieved from <https://jurnalmahasiswa.unesa.ac.id/index.php/jurnal-pendidikan-teknik-elektro/article/view/10273>
- Khaldum, M. I. (2016). Tingkat keterbacaan wacana nonfiksi pada buku teks Bahasa Indonesia pegangan siswa Kelas X Kurikulum 2013 dengan menggunakan metode Grafik Fry. *Jurnal Humanika*, 16(1), 1-19. Retrieved from <http://ojs.uho.ac.id/index.php/HUMANIKA/article/view/4077>
- Kulsum, N. U. (2018). Mind Mapping Model in increasing students creativity and learning outcomes. *Classroom Action Research Journal (CARJO)*, 2(3), 127-132. doi: <https://doi.org/10.17977/um013v2i32018p127>
- Leeds, A. J., Kudrowitz, B., & Kwon, J. (2018). Mapping associations: Exploring divergent thinking through Mind Mapping. *International Journal of Design Creativity and Innovation*, 1-14. doi: <https://doi.org/10.1080/21650349.2018.1463178>
- Liu, Y., Zhao, G. & Bo, Y. (2014). The effect of Mind Mapping on teaching and learning: Meta-Analysis. *Standard Journal of Education and Essay*, 2(1), 017-031. Retrieved from [https://www.researchgate.net/publication/297833919\\_The\\_Effect\\_of\\_Mind\\_Mapping\\_on\\_Teaching\\_and\\_Learning\\_A\\_Meta-Analysis](https://www.researchgate.net/publication/297833919_The_Effect_of_Mind_Mapping_on_Teaching_and_Learning_A_Meta-Analysis)
- Long, D. & Carlson, D. (2011). Mind the Map: How thinking maps affect student achievement. *Journal Networks for Teacher Research*, 13(2), 1-7. doi: [10.4148/2470-6353.1083](https://doi.org/10.4148/2470-6353.1083)

- Maharani, H. R., Waluya, S.B., & Sugianto. (2015). Humanistic Mathematics Learning with creative problem solving assisted Interactive Compact Disk to improve creative thinking ability. *International Journal of Education and Research*, 3(1). Retrieved from <https://www.ijern.com/journal/2015/January-2015/17.pdf>
- Malycha, C. P., & Maier, G. W. (2017). The Random-Map Technique: Enhancing Mind-Mapping with a Conceptual Combination Technique to foster creative potential. *Creativity Research Journal*, 29(2), 114-124. doi: [10.1080/10400419.2017.1302763](https://doi.org/10.1080/10400419.2017.1302763)
- Mazidah, I. N., Widodo, W., Purnomo, & Aris R. (2019). Kevalidan LKPD berbasis *Predict-Observe-Explain* untuk melatih kemampuan literasi sains peserta didik Kelas VII. *eJournal Pensa*, 7(2), 239-243. Retrieved from <https://ejournal.unesa.ac.id/index.php/pensa/article/view/28224>
- Munandar, U. (2012). *Pengembangan kreativitas anak berbakat*. Jakarta: Rineka Cipta
- Nisa, A.Z., Alimah, S., & Marianti, A. (2016). Pengaruh penerapan desain pembelajaran animalia dengan Model Eksperiental Jelajah Alam Sekitar di SMA. *Jurnal Lembaran Ilmu Kependidikan*, 45 (1), 20-27. Retrieved from <https://journal.unnes.ac.id/nju/index.php/LIK/article/view/7638>
- Prastowo, A. (2015). *Panduan kreatif membuat bahan ajar inovatif*. Yogyakarta: Diva Press.
- Puspitasari, L., In'am, A., Syaifuddin, M. (2019). Analysis of students' creative thinking in solving Arithmetic problems. International Electronic Journal of Mathematics Education**, 14(1): 49-60. <https://doi.org/10.12973/iejme/3962>
- Rachmani, A. (2011). *Aplikasi: Perkembangan dan penerapannya*. Jakarta: Gramedia
- Ramadhani, W. P., & Mahardika, I. K. (2015). Kegrafikaan Modul Pembelajaran Fisika Berbasis Multirepresentasi. *Seminar Nasional Fisika dan Pembelajarannya*. 85-91. Retrieved from [http://fmipa.um.ac.id/wp-content/uploads/Prosiding2015/Media/Fisika2015\\_01-Media-Wachida-Putri.pdf](http://fmipa.um.ac.id/wp-content/uploads/Prosiding2015/Media/Fisika2015_01-Media-Wachida-Putri.pdf)
- Septiaji, A. (2015). Pembelajaran berbasis *iMindMap* dalam meningkatkan keterampilan menulis wacana argumentasi. *Riksa Bahasa*, 1 (2), 132-145. doi: <https://doi.org/10.17509/rb.v1i2.8754>
- Supriadi. (2016). Efektivitas Metode Mind Mapping dalam meningkatkan kemampuan menyimak dongeng di Kelas 1 SD Inpres Panreng Kabupaten Barru. *Jurnal Publikasi Pendidikan*, 6(2), 83-89. doi: <https://doi.org/10.26858/publikan.v6i2.1895>
- Susantini, E., Isnawati, & Lisdiana, L. (2016). Effectiveness of Genetics student worksheet to improve creative thinking skills of teacher candidate students. *Journal of Science Education*, 17(2), 74-79. Retrieved from [https://www.researchgate.net/publication/310254538\\_Effectiveness\\_of\\_genetics\\_student\\_worksheet\\_to\\_improve\\_creative\\_thinking\\_skills\\_of\\_teacher\\_candidate\\_students](https://www.researchgate.net/publication/310254538_Effectiveness_of_genetics_student_worksheet_to_improve_creative_thinking_skills_of_teacher_candidate_students)
- Taadi, D., Raharjo, T. J., & Deliana, S. M. (2019). The effect of Mind Mapping Based *iMindMap* Application on the creativity and concept understanding of students. *Innovative Journal of Curriculum and Educational Technology*, 8(1), 41-50. Retrieved from <https://journal.unnes.ac.id/sju/index.php/ujet/article/view/31337>
- Wheeldon, J. (2011). Is a picture worth a thousand words? Using mind maps to facilitate participant recall in qualitative report. *The Qualitative Report*, 16(2), 509-522. Retrieved from <https://nsuworks.nova.edu/tqr/vol16/iss2/11>
- Widjajanti, E. (2008). Kualitas Lembar Kerja Siswa (LKS). *Seminar pengabdian masyarakat: Pelatihan penyusunan LKS Mata Pelajaran Kimia berdasarkan KTSP bagi guru SMK/MAK*. Yogyakarta: 22 Agustus 2008. 1-7. Retrieved from <http://staff.uny.ac.id/sites/default/files/pengabdian/ endang-widjajanti-afx-ms-dr/kualitas-lks.pdf>
- Widyaningsih, N., & Zuchdi, D. (2015). Uji keterbacaan wacana buku teks Bahasa Indonesia Kelas V SD Negeri di Kecamatan Wonogiri. *Jurnal Ling Tera*, 2(2), 144-155. doi: <https://doi.org/10.21831/lt.v2i2.7373>
- Yeong, F. M. (2013). Incorporating Mind-maps in Cell Biology Lectures - A reflection on the advantages and potential drawback. *Journal of Procedia*, 103(2013), 485-491. doi: <https://doi.org/10.1016/j.sbspro.2013.10.364>
- Zubaidah, S., Fuad, N. M., Mahanal, S., & Suarsini, E. (2017). Improving creative thinking skills of students through differentiated science inquiry integrated with mind map. *Journal of Turkish Science Education*. 14(4), 77-91. doi: <https://doi.org/10.12973/tused.10214a>