

Analysis of Student Creativity in Developing Science Learning Media during the COVID-19 Pandemic

Ulyawati ¹, Woro Sri Hastuti ², Ali Mustadi ³

DOI: 10.35445/alishlah.v13i3.612

Article Info	Abstract
<p>Keywords: <i>Creativity;</i> <i>Media;</i> <i>Science Learning</i></p>	<p>This study aims to ascertain (1) the inventiveness of university students in developing digital media for science education. (2) provides an overview of elementary science media applications that students can develop, and (3) discusses the obstacles students encountered while developing digital media for elementary science learning during COVID-19. This study took place at Yogyakarta State University and Makassar State University. The sample size for this study is 142 students, including 71 UNM students and 71 UNY students. The approach is descriptive with a quantitative component. Thus, the results demonstrated students' creativity in developing science media during the COVID-19 pandemic, as measured by five characteristics: fluency, flexibility, originality, elaboration, and sensitivity. Students can create media by using applications such as PowerPoint, Articulate Storyline, Flipbook Maker, Wondershare Filmora, and a variety of other supporting platforms (websites). However, students face obstacles in four areas when developing media, including fluency, flexibility, originality, and elaboration, namely (1) students continue to struggle with integrating science learning media into elementary school through the use of appropriate approaches/models/learning methods, (2) determining the variety of problem-solving strategies available to users of science learning media in elementary school, and (3) determining the variety of problem-solving strategies available to users of science learning media in elementary school. (3) difficulty identifying science learning media for elementary schools located in areas without internet access due to the COVID-19 pandemic and others.</p>
<p>Kata kunci: <i>Kreativitas</i> <i>Media</i> <i>Pembelajaran IPA</i></p>	<p>Abstrak</p> <p>Penelitian ini bertujuan untuk mengetahui (1) kreativitas mahasiswa dalam mengembangkan media digital terfokus pada pembelajaran IPA (2) memberikan gambaran penerapan media IPA SD yang dapat dikembangkan mahasiswa dan (3) hambatan yang dialami mahasiswa dalam mengembangkan media digital pada pembelajaran IPA SD pada masa COVID-19. Lokasi penelitian ini dilakukan di Universitas Negeri Yogyakarta dan Universitas Negeri Makassar. Kemudian sampel dalam penelitian ini yaitu 142 mahasiswa, jika dijabarkan terdiri dari 71 Mahasiswa UNM dan 71 Mahasiswa UNY. Adapun metode yang digunakan yaitu deskriptif dengan pendekatan kuantitatif. Sehingga hasil yang didapatkan menunjukkan kreativitas mahasiswa yang</p>

¹ Universitas Negeri Yogyakarta, Yogyakarta, Indonesia
Email: ulyawati.2020@student.uny.ac.id

² Universitas Negeri Yogyakarta, Yogyakarta, Indonesia
Email: woro_srihastuti@uny.ac.id

³ Universitas Negeri Yogyakarta, Yogyakarta, Indonesia
Email: ali_mustadi@uny.ac.id

berkategori baik berdasarkan lima aspek yaitu kefasihan, fleksibilitas, orisinalitas, elaborasi dan kepekaan dalam mengembangkan media IPA pada masa pandemi COVID-19. Adapun beberapa media yang dapat dikembangkan mahasiswa yaitu mahasiswa dapat membuat video, gambar, teks, animasi, audio, dan suara dengan menggunakan aplikasi seperti *Power Point*, *Articulate Storyline*, *Flipbook Maker* dan *Wondershare Filmora* serta beberapa platform (website) penunjang lainnya. Namun dalam mengembangkan media mahasiswa juga memiliki beberapa hambatan pada empat aspek diantaranya kefasihan, fleksibilitas, orisinalitas, dan elaborasi yaitu (1) mahasiswa masih kesulitan dalam mengintegrasikan media pembelajaran IPA di SD dengan menggunakan pendekatan/model/metode pembelajaran yang sesuai, (2) menentukan ragam pemecahan masalah untuk pengguna (user) media pembelajaran IPA di SD (3) kesulitan dalam menentukan media pembelajaran IPA di SD jika berada di daerah tanpa akses internet pada masa pandemi COVID-19.

INTRODUCTION

Quality human resources begin with quality education. Thus, the primary goal of human resource development is to develop intelligent human beings who possess personalities, self-control, and proficiency and the skills necessary to meet the demands of their lives as they change. The pandemic of COVID-19 triggered a global health crisis (Whitelock- et al., 2021). This has resulted in the closure of schools and educational facilities in a number of countries, both elementary and secondary (Humphrey and Wiles 2021; Fauziddin et al., 2021). Thus, all levels of educational institutions, from elementary to college, will suffer negative consequences as a result of online learning conducted from home (Harunasari et al., 2021). It is also evident in students' learning experiences enrolled in the Primary School Teacher Education Study Program, one of the premier institutions for aspiring elementary school teachers, making one of the courses, such as elementary science education, more complex. This course is directly proportional to the elementary school curriculum. To promote student creativity, including media creation (Mirzon Daheri, Juliana, Deriwanto, 2020).

This is because the use of media in Science aids students in their comprehension of the concept of Science. Additionally, the use of educational media has an effect on the interests and success of future educators who interact with their students. As a result, it isn't easy to conduct effective learning (Mulyani & Jannah, 2020; Chung & Cheon, 2020). Thus, creativity is a necessary ability in a cognitive activity that involves resolving specific problems or conditions through an experiential process that results in a variety of novel ideas or solutions when developing Science media to deliver Science material to learners (Martins Gomes & McCauley, 2021).

Therefore, measuring one's creativity can be done by one of them on a Non-Test basis, such as checklists and questionnaires and a list of experiences. As for the characteristics of creative thinking, according to Munandar (Astuti et al., 2020), namely (1) the ability to produce many opinions or answers relevant to a smooth way of thinking (fluency), (2) with similar opinions that can change different ways or approaches and ways of thinking (flexibility), (3) the ability to answer in an unusual way, which is different from others, and the answers given are different from most people (Originality), and (4) the ability to develop, add and enrich careful opinions to become more attractive (Elaboration) and (5) last sensitivity (sensitivity). Therefore, creativity is needed in helping prospective educators in developing science media, especially in making good media that can be used during the COVID-19 pandemic.

Based on observations made at Yogyakarta State University and Makassar State University in March 2021, students are dominant in using presentation-focused learning media. They are still lacking in developing interactive media of science learning in teaching or studying in elementary science education courses during the COVID-19 pandemic. This problem is also similar to some research, showing that the students as prospective educators to educators and lecturers are still not

very proficient in teaching through internet technology learning media or online, especially those in the area (Rahman et al., 2021).

This is due to the limitations associated with mastering the ability to create engaging and interactive media for use during the COVID-19 pandemic. Due to a lack of training in media production, particularly in science education, problems frequently arise during the field learning process, specific complaints about the ineffective use of learning media, which results in students being less engaged and interested in the materials taught (Artayasa, 2020). This is because of issues that begin within the learning environment of prospective educators themselves, where lectures are more prevalent when using a presentation-based learning model. Thus, the findings indicate that students continue to lack creativity, particularly when designing or developing science learning media (Mirzon Daheri, Juliana, Deriwanto, 2020). Then additional research demonstrates that prospective teachers must first understand the concept of media development (Mulyani & Jannah, 2020). Additionally, other studies have demonstrated that students, despite the COVID-19 pandemic, exhibit a high level of creativity when developing mathematical learning media (Nurhayati & Rahardi, 2021).

The study's findings demonstrate that creativity skills are critical to design learning media in the twenty-first century (Henriksen et al., 2017). As for some relevant research, namely the first Selegi (2019), which discusses the analysis of PGSD students' creative thinking abilities in developing test form descriptions to improve students' soft skills. Demonstrating the results of students' creative thinking abilities, flexibility, originality, and elaboration can help students improve their soft skills when designing the test form description for class V elementary school. In designing thinking training, Rao et al. (2021) found that it increased creativity. The findings of an experiment conducted in the field with middle school students. Demonstrating design thinking training increased confidence and ideationality, fluency, and elaboration in divergent thinking tasks, even though the treatment group's resulting ideas were on average less original and flexible than the control group's. Wiyoko (2019), study on the profile analysis of critical thinking abilities of PGSD students using graded response models in science learning.

However, some of the research presented has not provided an overview of students' level of creativity in developing learning media (digital) focused on elementary science learning and has not presented the obstacles experienced by students in developing elementary science learning media during the COVID-19 period. So this research is important for prospective teachers who are required to increase their creativity in developing elementary science learning media. Because considering the creative skills that are the key to the success of prospective teachers in developing their own media, to help prospective teachers achieve learning goals well.

Therefore, this research is expected to improve students' creativity in developing science learning media during COVID-19. The purpose of this research is to know (1) the creativity of PGSD students in developing digital media focused on learning science (2) provides an overview of the application of elementary science media that can be developed by students and (3) obstacles experienced by students in developing digital media in elementary science learning during COVID-19.

METHOD

This type of research uses descriptive methods to describe the symptoms, events, or events that occur. Then the research approach used is quantitative. According to Sugiyono (Akbari & Irawan, 2021), quantitative data is data in the form of numbers. So this study only aims to describe variables as they are with numbers and not to test hypotheses. This research was held at Yogyakarta State University and Makassar State University conducted from March to May 2021. The population of this research is all students of semester 4 of the primary school teacher education program (PGSD), namely 318 students, obtained from 192 students from UNM and 126 students from UNY. So the

sample in this study is 142 students, if described consists of 71 students UNM and 71 Students UNY. In addition, when viewed from the gender of 130 women (91.5%) and 12 males (8.5%), ranging from 17 to 24 years. Determination of samples used is purposive sampling, a sampling technique based on a certain consideration (Sugiyono, 2017).

Students who studied science education courses in elementary school, particularly physics and biology, then studied the materials for elementary science learning practices and created digital science media during the learning process of elementary science learning courses and research and research practices the considerations. The data in this study were analyzed quantitatively and descriptively. The variable in this study is students' creativity in developing science education media. Then, data collection techniques include observation and questionnaires. According to Widoyoko (Sumarsono, 2018), conducting instrument trials is preceded by the preparation of instruments by instrument development rules, the identification of variables to be investigated, the formulation and compilation of conceptual definitions, and the compilation of a grid of instruments and instrument items. Following that, the instrument is validated by experts (expert judgment), which can be subjected to further trials and testing. Thus, the research instrument used in this study was valid and reliable, as determined by expert judgment and ongoing instrument trials.

This study used an instrument in a questionnaire consisting of 35 closed question items and four open questions. Here is a grid of questionnaire guidelines. There are 5 important aspects in measuring student creativity in developing science learning media, according to Guilford (Irwandi, 2020; Arifin et al., 2020):

Table 1. Students' creativity in developing natural science learning media

No	Aspects	Questionnaire Statement Item		Number of Items
		(+)	(-)	
1.	Fluency	1,4,5	3,2,6	6
2.	Flexibility	8,9,10,13,14,15	7,11,12,16	10
3.	Originality	17,19,21	18,20,22	6
4.	Elaboration	25,28,31	23,24,26,27,29,30	9
5.	Sensitivity	32,34	33,35	4

In this study, the spread of questionnaires through the google form application to be filled, as for the link is <https://forms.gle/uSbshdKUXtj4LVfg7>. In answering the formulation of this research problem, the data is collected using percentage or relative frequency calculations.

The result of the formula is described using the terms, using the reference of the Sujono (Akbari & Irawan, 2021), that is:

Table 2. Score interpretation

Percentage	Information
75%-100%	Excellent
50%-74%	Good
25%-49%	Pretty good
≤ 24%	Not good

FINDINGS AND DISCUSSION

The results of this study used 5 aspects, namely fluency, flexibility, originality, elaboration, and sensitivity (Irwandi, 2020; Arifin et al., 2020), to know the creativity of PGSD students in developing science learning media during the COVID-19 pandemic, namely:

Descriptive analysis of fluency aspects

As in fluency, there is a close relationship between achieving goals and creativity (Arifin et al., 2020). According to Munandar (Irwandi, 2020), fluency is characterized by students thinking creatively and bringing up many ideas. As the data obtained dominantly shows, such as item 1, 73.9% of students can use various ways in developing science learning media in elementary schools during the COVID-19 pandemic. Item 2, which is 50% disagree if they have difficulty in giving ideas or proposals in developing science learning media in elementary school. Item 3, 77.5% agreed if students can identify suitable media in science learning in elementary school. Item 4, 52.1% disagree if it is difficult to provide alternative options for science learning media in elementary schools, especially during the COVID-19 pandemic. Item 5, 65.5%, agrees that they will develop if they easily get a solution or idea about the learning media. Item 6, 52.8%, agreed if students have difficulty integrating science learning media in elementary school with the appropriate approach/model/method of learning. The complete data are presented in table 3 below:

Table 3. Fluency aspect

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Item 1	17,6	73,9%	7,7%	0,7%
Item 2	1%	47,2%	50%	0,7%
Item 3	11,3%	77,5%	10,6%	2,1%
Item 4	4,2%	41,5%	52,1%	0,7%
Item 5	7%	65,5%	26,8%	0,7%
Item 6	3,5%	52,8%	42,3%	1,4%

Thus, based on the fluency aspect, demonstrating that students can meet the smooth aspect of developing digital science learning media during the COVID-19 pandemic, which has used a variety of methods in developing natural science learning media, providing ideas or proposals for developing natural science learning media, identifying appropriate media for science learning, and has been able to provide solutions or ideas for learning media that they will develop. However, students continue to struggle with integrating science learning media into elementary school by using an appropriate approach/model/method of learning.

Descriptive analysis of flexibility aspects

According to Munandar (Irwandi, 2020), the flexibility aspect has the characteristics of students who can generate new ideas that vary. This positively influences the cognitive flexibility of creativity, as the former will be needed to generate new or unusual ideas and switch between widely unrelated concepts (Arán Filippetti &Krumm, 2020). As for the data results obtained, dominantly give answers as in item 7, namely 57% agree if students have difficulty determining the variety of problem-solving for users (users) of science learning media in elementary school. Item 8, 65.5% agree that students can easily determine questions that vary according to the user's needs. Item 9, which is 70.4% agree if students easily compose materials on natural science media in elementary school from various sources of appropriate reference. Item 10 is 66.9% agree if students can analyze the needs of students (users) before starting to develop learning media. Item 11, which is 63.4% disagree if they do not care about the learning style of elementary school students as users. Item 12, which is 54.9% disagree if students have difficulty determining alternative media that can meet the purpose of learning science in elementary school. Item 13, which is 75.4% agree if students can help students (users) have a variety of learning activities. Item 14, which is 71.1% agreed if students can determine the problem-solving in natural science learning media in elementary school developed. Item 15, which is 66.9% agree, if in developing natural science media in elementary school does not have internet access, then make the media-based offline. Last Item 16, 48.6% agreed that students have difficulty in determining science learning media in elementary schools if they are in areas

without internet access during the COVID-19 pandemic. The complete data are presented in table 4 below:

Table 4. Flexibility aspect

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Item 7	3,5%	57%	38%	1,4%
Item 8	7,7%	65,5%	26,1%	0,7%
Item 9	12,7%	70,4%	15,5%	1,4%
Item 10	29,6%	66,9%	2,8%	0,7%
Item 11	0,7%	13,4%	63,4%	0,7%
Item 12	2,1%	39,4%	54,9%	3,5%
Item 13	9,9%	75,4%	14,1%	0,7%
Item 14	5,6%	71,1%	21,8%	1,4%
Item 15	27,5%	66,9%	4,9%	0,7%
Item 16	12,7%	48,6%	32,4%	6,3%

By categorizing digital media in science learning well, students can easily determine questions that vary according to user needs and can compile scientific materials in natural science media for primary schools by using appropriate reference sources. It appears that students have fulfilled the aspect of flexibility. Before creating media, students can assess the wants and needs of the intended audience, which allows them to consider the learning styles of elementary school students when creating content. They can then use this information to develop media that are better suited to the needs of elementary school students and provide them with a wider range of learning activities. Because of this, it is difficult for elementary school students to determine the variety of problem-solving techniques that can be used in the classroom, and it is even more difficult for students who live in areas without internet access to find science learning media for elementary school students.

Descriptive analysis of the Originality aspect

Creativity is a blend of originality and usability (valuable, meaningful) as defined in a particular context (Zanden et al., 2020). Traditionally, creative people can produce creative products. Based on data obtained to measure the creativity of PGSD students in developing digital media in science learning during the COVID-19 pandemic on the dominant aspect of originality answered; item 17 that is 77.5% agreed in producing science learning media in elementary school that is innovative, item 18 is 66.9% expressed disapproval if the difficulty of producing interesting science learning media, item 19 that is 72.5% agreed to develop science learning media in primary school that combines offline and online-based, item 20 is 51.4% disagree if the difficulty in connecting other learning materials in one learning medium, item 21 is 52.8% do not agree if they can design a virtual laboratory as a learning media natural sciences in elementary school. Item 22 is 48.6% which is to agree if the difficulty of designing learning media that displays simulations of natural sciences activities in elementary school. The complete data are presented in table 5 below:

Table 5. Aspects of Originality

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Item 17	10,6%	77,5%	1,3%	0,7%
Item 18	2,8%	24,6%	66,9%	5,6%
Item 19	12%	72,5%	14,1%	1,4%
Item 20	2,8%	41,5%	51,4%	4,2%
Item 21	1,4%	44,4%	52,8%	1,4%
Item 22	3,5%	48,6%	42,3%	5,6%

Accordingly, students' ability to develop digital-based science media with good categories in the COVID-19 pandemic, where students were able to develop innovative, interesting media, combining offline and online activities in one medium, can be concluded, but some obstacles are difficulty in designing learning media that displays simulations of Natural Science activities in elementary schools. This can be a consideration of the level of complexity in creating a virtual lab and the lack of training in its manufacture. This can be taken into consideration in teaching students because, according to Arifin's research et al. (Arifin et al., 2020) explaining the use of virtual labs in the learning process can help students in the process of investigation and experimentation without thinking about the limitations of time, tools and materials that have been constraints on practical activities.

Descriptive analysis of aspects of elaboration

Creativity is an ability that connects seemingly unrelated knowledge into blending into existing new insights into some elements of how to work (Gamalo, 2021). One aspect of creativity is elaboration with characteristics. According to Munandar (Irwandi, 2020), students can enrich interesting and complex ideas. Based on the data obtained, the dominant students answered item 23, which is 68.3%, agreed if students first saw the learning media created by others before making science learning media in elementary school. Item 24 is 57% disagree if students have difficulty getting inspiration in designing science learning media in elementary school. Item 25 is 73.9% agree, if it can provide observation objects, either in the form of images, videos, or animations in the learning media of primary education science developed. Item 26 is 57.7% disagree with the difficulty in detailing the stages of learning activities in elementary school's natural science learning media. Item 27, which is 62% agree if it can provide images and videos as a supporter of natural science learning media in elementary school. Item 28, which is 66.2%, agreed to provide a support table for natural science learning media for elementary school. Item 29 is 70.4% disagree if they do not provide text to support natural science learning media in elementary school. Item 30 is 51.4% disagree if the difficulty in integrating natural science learning model in the learning media developed. Item 31 is 71.1% agree if detailing the problems listed in developing the media. The complete data are presented in table 6 below:

Table 6. Aspects of elaboration

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Item 23	20,4%	68,3%	8,9%	1,4%
Item 24	4,9%	35,9%	57%	2,1%
Item 25	22,5%	73,9%	2,8%	0,7%
Item 26	3,5%	33,8%	57,7%	4,9%
Item 27	33,8%	62%	3,5%	0,7%
Item 28	10,6%	66,2%	21,1%	2,1%
Item 29	0,7%	15,5%	70,4%	13,4%
Item 30	2,1%	44,4%	51,4%	2,1%
Item 31	8,5%	71,1%	19%	1,4%

So based on the aspect of elaboration, it shows that students have been able to meet the aspects of elaboration with good categories in developing digital-based Science media during the COVID-19 pandemic, where students have no difficulty in getting inspiration in designing science learning media in elementary school, they have been able to provide embedding objects in the form of images, videos, and animations. Has been able to provide supporting materials in the form of images and videos and provide supporting tables. There is no difficulty in detailing the stages of learning activities in the natural science learning media and integrating the natural science learning model in the developed learning media. And has been able to detail the problems listed in the media. But still,

under consideration, students still see the learning media made by others before making science learning media in elementary school.

Descriptive analysis of sensitivity aspects

Creativity and creative learning take a role in the long-term memory of potential learners, so they must develop professional skills and knowledge to facilitate the development of learners' creative responses (Davies et al., 2013). Such as sensitivity aspects in creativity that students can identify, recognize, understand, and respond to a situation or problem. (Irwandi, 2020). Based on the data obtained, the dominant answer item 32, 79.6%, agrees if it can determine suitable feedback after the developed media is used. Item 33 is that 61.3% disagree if difficulties with natural science materials in elementary school are taught. Item 34 is 54.2% agree, if it is easy to create interactive learning media of natural sciences in Elementary School. As well as item 35 that is 50% disagree if the difficulty in making natural science learning media in elementary school that is up to date in accordance with the development of the times. The complete data is presented in table 7 below:

Table 7. Sensitivity aspect

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Item 32	9,2%	79,6%	10,6%	0,7%
Item 33	0,7%	34,5%	61,3%	3,5%
Item 34	9,9%	54,2%	35,2%	0,7%
Item 35	3,5%	39,4%	50%	7%

Students have been successful in developing digital-based Natural Science media in response to the COVID-19 pandemic, as evidenced by the data obtained regarding the sensitivity aspect. Students have been able to determine appropriate feedback after using the media developed and have no difficulty with natural science materials in elementary schools taught, as evidenced by their ability to develop interactive learning media.

Descriptive analysis of the media that students can develop

Based on the results of the questionnaire shared by the media that can be developed by students, in the form of video (74.6%), images (69.7%), text (45.1%), animation (44.4%), audio (35.2%), sound (26.8%). In addition, data was obtained by several applications dominated by students during the COVID-19 pandemic, namely powerpoint (89.4%), the articulate storyline (23.9%), flipbook maker (22.5%), and wondershare filmora (12.7%). Then, in addition to information, some platforms (websites) that have been used are canvas, youtube, powtoon, google classroom, prezi, and quizzes.

Descriptive analysis of digital development capabilities

Through the form of evaluation in questionnaires related to this study. So as for the results of their self-assessment of the ability to develop natural science media in elementary school, especially in digital media, namely dominant self-assessment is categorized well with a percentage of 58.5%, less good (35.9%), and very good (5.6%).

CONCLUSION

Fluency, flexibility, originality, elaboration and sensitivity in developing science media during the covid-19 pandemic were all found to be characteristics of students who were well categorized by the results of a survey conducted at two universities. In terms of media creation, students have the option to produce various forms of video and image content as well as written text, animation, and audio and sound recordings. These include Flipbook Maker and Wondershare Filmora for supporting applications and powerpoint and articulate storyline. Additionally, canva, youtube, powtoon, google classroom, prezi, and quiziz are some of the websites that can be used. When it comes to creating the media, however, students face several challenges, including (1) the difficulty of

incorporating natural science learning media into elementary school curricula by using appropriate approaches/models/learning methods, and (2) determining the range of problem-solving strategies for elementary school users of Natural Science learning media. (4) They have not been able to design a virtual laboratory as a learning medium for Natural Sciences in Elementary School and (5) they still see the learning media created by others before determining natural science learning media in elementary school during the COVID-19 pandemic if they are in an area without internet access.

This study has limitations since it can only explain student creativity in developing natural science learning media for digital elementary schools. As a result, researchers recommend that future researchers look into how PGSD students in non-digital elementary schools develop natural science media. Training on Natural Science media development during the COVID-19 pandemic, which focuses on integrating media with appropriate approaches/models/learning methods, assisting students in designing a variety of problem-solving for Natural Sciences for Elementary School users, and creating a variety of problem-solving for Natural Sciences for Elementary School users Besides that, researchers are hoping that this research can be used as a basis for further research into improving elementary school students' creativity in the development of natural science educational media.

REFERENCES

- Akbari, S. I., & Irawan. (2021). Implementation of Scientific Integration in Learning toward the Formation of Student ' s Akhlak. *Al-Ishlah: Jurnal Pendidikan*, 13(1), 62–71.
- Arán Filippetti, V., & Krumm, G. (2020). A hierarchical model of cognitive flexibility in children: Extending the relationship between flexibility, creativity and academic achievement. *Child Neuropsychology*, 26(6), 770–800. <https://doi.org/10.1080/09297049.2019.1711034>
- Arifin, Z., Destiansari, E., & Amizera, S. (2020). Bioedusiana. *Bioedusiana*, 5(2), 123–130.
- Artayasa, I. P. (2020). Keterampilan Berpikir Kreatif Mahasiswa Dalam Pembelajaran Ipa Menggunakan Model Inkuiri Terbuka. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 8(1), 1–9. <https://doi.org/10.24815/jpsi.v8i1.15394>
- Astuti, A., Waluya, S. B., & Asikin, M. (2020). the Important of Creative Thinking Ability in Elementary School Students for 4.0 Era. *International Journal of Educational Management and Innovation*, 1(1), 91. <https://doi.org/10.12928/ijemi.v1i1.1512>
- Chung, S., & Cheon, J. (2020). Emotional design of multimedia learning using background images with motivational cues. *Journal of Computer Assisted Learning*, 36(6), 922–932. <https://doi.org/10.1111/jcal.12450>
- Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education-A systematic literature review. *Thinking Skills and Creativity*, 8(1), 80–91. <https://doi.org/10.1016/j.tsc.2012.07.004>
- Fauziddin, M., Mayasari, D., & Rizki, L. M. (2021). *Effective Learning for Early Childhood during Global Pandemic*. 13(1).
- Gamalo, M. (2021). Networked knowledge, combinatorial creativity, and (statistical) innovation. *Journal of Biopharmaceutical Statistics*, 31(2), 109–112. <https://doi.org/10.1080/10543406.2021.1907889>
- Harunasari, S. Y., Dwigustini, R., & Halim, N. (2021). *University Students ' Acceptance of Online Learning During the Pandemic in Indonesia*. 13(1).
- Henriksen, D., Richardson, C., & Mehta, R. (2017). Design thinking: A creative approach to educational problems of practice. *Thinking Skills and Creativity*, 26(October), 140–153. <https://doi.org/10.1016/j.tsc.2017.10.001>
- Humphrey, E. A., & Wiles, J. R. (2021). Lessons learned through listening to biology students during a transition to online learning in the wake of the COVID-19 pandemic. *Ecology and Evolution*, February, 3450–3458. <https://doi.org/10.1002/ece3.7303>
- Irwandi. (2020). *Strategi Pembelajaran Biologi (Lesson Study, Literasi Sains, dan Blended Learning)* (A. Budiman (ed.); Pertama). Pustaka Reka Cipta.
- J. A. C. van der Zanden, P., Meijer, P. C., & Beghetto, R. A. (2020). A review study about creativity in adolescence: Where is the social context? *Thinking Skills and Creativity*, 38(July), 100702.

- <https://doi.org/10.1016/j.tsc.2020.100702>
- Martins Gomes, D., & McCauley, V. (2021). Creativity in science: A dilemma for informal and formal education. *Science Education*, 105(3), 498–520. <https://doi.org/10.1002/sce.21614>
- Mirzon Daheri, Juliana, Deriwanto, A. D. A. (2020). Jurnal basicedu. *Peningkatan Kreativitas Mahasiswa Menggunakan Model Project Based Learning Dalam Pembuatan Media IPA Berbentuk Pop Up Book*, 3(2), 524–532.
- Muliyani, Y., & Jannah, M. (2020). *Jurnal Phi Kemampuan Mahasiswa Calon Guru dalam Mengembangkan Media dan Bahan Ajar IPA Berbasis Project Based Learning (PjBL)*. 1(3), 8–18.
- Nurhayati, N., & Rahardi, R. (2021). Kemampuan Berfikir Kreatif Mahasiswa Dalam Mengembangkan Media Pembelajaran Matematika Saat Pandemi Covid-19. ... *Pembelajaran Matematika ...*, 4(2), 331–342. <https://doi.org/10.22460/jpmi.v4i2.331-342>
- Rahman, M. H. A., Uddin, M. S., & Dey, A. (2021). Investigating the mediating role of online learning motivation in the COVID-19 pandemic situation in Bangladesh. *Journal of Computer Assisted Learning*, 2020(January), 1–15. <https://doi.org/10.1111/jcal.12535>
- Rao, H., Puranam, P., & Singh, J. (2021). Does design thinking training increase creativity? Results from a field experiment with middle-school students. *Innovation: Organization and Management*, 00(00), 1–18. <https://doi.org/10.1080/14479338.2021.1897468>
- Selegi, S. F. (2019). Analisis Kemampuan Berpikir Kreatif Mahasiswa PGSD Dalam Mendesain Soal Tes Bentuk Uraian Untuk Meningkatkan Soft Skills Mahasiswa. *JIKAP PGSD: Jurnal Ilmiah Ilmu Kependidikan*, 3(3), 217. <https://doi.org/10.26858/jkp.v3i3.10220>
- Sugiyono. (2017). Sugiyono. In *Penelitian (Pertama)*. Alfabeta.
- Sumarsono, A. (2018). Persepsi Guru Madrasah Ibtidaiyah (Mi) Dalam Menerapkan Kurikulum 2013 Di Kabupaten Merauke. *Jurnal Al-Ishlah: Jurnal Pendidikan*, 10(2), 156–170.
- Whitelock-, L. Y. A., Guan, Q., Wen, G., Gašević, D., & Chen, G. (2021). *Students ' experience of online learning during the COVID- - 19 pandemic : A province- - wide survey study*. March, 1–20. <https://doi.org/10.1111/bjet.13102>
- Wiyoko, T. (2019). Analisis Profil Kemampuan Berpikir Kritis Mahasiswa PGSD Dengan Graded Response Models Pada Pembelajaran IPA Analysis Of Capability Profile Of Critical Thinking Of PGSD Students With Graded Response On Science Learning. *Indonesian J. Integr. Sci. Education*, 1(1), 25–32.