**Binar Kurnia Prahani <binarprahani@unesa.ac.id>**

# [tused] Submission Acknowledgement

1 message

**Salih Çepni** <editortused@gmail.com> Tue, Oct 13, 2020 at 6:59 AM
To: "Dr, Binar Kurnia Prahani" <binarprahani@unesa.ac.id>

Dr, Binar Kurnia Prahani:

Thank you for submitting the manuscript, "Online Scientific Creativity Learning (OSCL) in Higher Education to Improve Students' Scientific Creativity in Covid-19 Pandemic" to Journal of Turkish Science Education. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Submission URL: https://www.tused.org/index.php/tused/authorDashboard/submission/1147
Username: binarkurniaprahani

If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

Salih Çepni

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Journal of Turkish Science Education

**Binar Kurnia Prahani <binarprahani@unesa.ac.id>**

# Decision on Manuscript Submitted to TUSED

4 messages

**AYŞEGÜL SAĞLAM ARSLAN** <asaglam-arslan@trabzon.edu.tr> Mon, Mar 15, 2021 at 8:57 PM
To: binarprahani@unesa.ac.id, mergisi <mergisi@trabzon.edu.tr>, srirahayu_um@hotmail.com, asaglam_arslan <asaglam_arslan@yahoo.fr>

Dear Author(s)
We are happy to inform you that your manuscript entitled " Online Scientific Creativity Learning (OSCL) in Higher Education to Improve Students' Scientific Creativity in Covid-19 Pandemic" is accepted for publication in the special issue of TUSED with major revisions. Reviewers' comments are attached as word documents. Please submit the revised manuscript within **three weeks**. While revising your paper please use track changes.
Should you have any queries, please feel free to contact us.
Sincerely,

Ayşegül SAĞLAM ARSLAN, PhD.
Meral BEŞKEN ERGİŞİ, PhD.
Sri RAHAYU, PhD.

**2 attachments**

**A4_Evaluation Form (1).docx**
20K

**A4_Evaluation Form (2).docx**
18K

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**Binar Kurnia Prahani** <binarprahani@unesa.ac.id> Sat, Apr 3, 2021 at 10:5
To: AYŞEGÜL SAĞLAM ARSLAN <asaglam-arslan@trabzon.edu.tr>

Dear Ayşegül SAĞLAM ARSLAN, PhD.

Thanks to editors and reviewers for having spent a great deal of time and care to provide positive recommendations for our manuscript. Researchers welcome all positive recommendations with pleasure because reviewer feedback has greatly helped improve the quality of our manuscript, title: Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic. Researchers have revised all feedback from the reviewer (attached).

But we have a new email form TUSED in below.

*[tused] Editor Decision* *Inbox*

***Ümmühan Ormancı*** *ummuhan45@gmail.com via tused.org* *Fri, Apr 2, 5:14 PM (1 day ago)*

*to me*

*Dr, Binar Kurnia Prahani:*

*We have reached a decision regarding your submission to Journal of Turkish Science Education, "Online Scientific Creativity Learning (OSCL) in Higher Education to Impro Students' Scientific Creativity in Covid-19 Pandemic".*

*Our decision is: Revisions Required*

*Ümmühan Ormancı*
*Dr.*
*ummuhan45@gmail.com*

------------------------------------------------------

*Reviewer A:*

***The subject of the article is important and currently is take attention by many science educators and researcher. It is well organized and includes current literat and has capacity to make contribution science and on distance education.***

***However, some weaknesses should be full filled. These are,***

1. ***Some clear research questions at the end of the literature review should be posed.***
2. ***More explanation about implementation of research should be given. Especially, duration of implementations and how many activities are used during implementation.***
3. ***The development of SCTI (Table.2) and Rubric (Table 3) should be given in detail.***
4. ***Why Some references are given under the Table 2 is not understandable.***
5. ***Conclucion part is too weak. It includes only finding summary. It should give some original ideas driven from the findings.***

*Recommendation: Revisions Required*

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*Reviewer B:*

*In the COVID-19 pandemic, the authors developed the online Scientific Creativity Learning (OSCL) model to enhance the creativity of higher education students and compa the effect of this model with Creativity Responsibility Based Learning (CRBL), except with Conventional learning models. Along with the contribution provided by the article, there are sections that the authors must rewrite. For this reason, I recommend that the authors make changes to the article proposal according to the review. After these changes are made, it would be appropriate to reconsider the manuscript.*

*Recommendation: Revisions Required*

*------------------------------------------------------*

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*Journal of Turkish Science Education*

## *[tused] Submission ORCID* Inbox

***Salih Çepni*** *via tused.org*

*to me*

*Dear Dr, Binar Kurnia Prahani,*

*You have been listed as an author on a manuscript submission to Journal of Turkish Science Education.*
*To confirm your authorship, please add your ORCID id to this submission by visiting the link provided below.*

*Register or connect your ORCID iD*

*More information about ORCID at Journal of Turkish Science Education*

*If you have any questions, please contact me.*

*Salih Çepni*

---

*Journal of Turkish Science Education*

We ask for direction and solutions from the TUSED editors. Thank you very much.

**Best Regards,**

**Binar Kurnia Prahani**
**Universitas Negeri Surabaya**

[Quoted text hidden]

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**AYŞEGÜL SAĞLAM ARSLAN** <asaglam-arslan@trabzon.edu.tr> Mon, Apr 5, 2021 at 2:17 PM
To: Binar Kurnia Prahani <binarprahani@unesa.ac.id>

Dear Binar Kurnia Prahani,
We have received your revised manuscript. We will be in touch soon.
Best,
Prof. Dr. Aysegul Saglam Arslan

Binar Kurnia Prahani <binarprahani@unesa.ac.id>, 3 Nis 2021 Cmt, 18:52 tarihinde şunu yazdı:
[Quoted text hidden]

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**Binar Kurnia Prahani** <binarprahani@unesa.ac.id> Mon, Apr 5, 2021 at 2:46 PM
To: AYŞEGÜL SAĞLAM ARSLAN <asaglam-arslan@trabzon.edu.tr>

Dear Prof. Dr. Ayşegül SAĞLAM ARSLAN
[Quoted text hidden]
[Quoted text hidden]

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**2 attachments**

**Rebuttal Letter_TUSED_Binar Kurnia Prahani et al.docx**
24K

**00 4 TUSED_Binar Kurnia Prahani et al.doc**
1152K

Binar Kurnia Prahani <binarprahani@unesa.ac.id>

# Final templete

3 messages

**TUSED/TUFED EDİTORÜ** <editortused@gmail.com> Wed, Sep 8, 2021 at 6:37 PM
To: binarprahani@unesa.ac.id

Dear Binar Prahani,

We sent you your article's final version and our journal's template. Please fix your manuscript and arrange your article according to the template for the final PDF as soon as possible. We already published the titles and abstracts and are waiting for your final PDF.

Regards

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Editor in
Journal of Turkish Science Education
Prof. Dr. SALİH ÇEPNİ

**2 attachments**

**A4_ TUSEDRevisedPaper Rev.doc**
1131K

**TUSED Template.12.03.2021 (1).docx**
288K

**TUSED/TUFED EDİTORÜ** <editortused@gmail.com> Wed, Sep 8, 2021 at 6:50 PM
To: binarprahani@unesa.ac.id

Please send it as a word document. We will adapt it to PDF after some procedures.

TUSED/TUFED EDİTORÜ <editortused@gmail.com>, 8 Eyl 2021 Çar, 14:37 tarihinde şunu yazdı:
[Quoted text hidden]

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[Quoted text hidden]

**Binar Kurnia Prahani** <binarprahani@unesa.ac.id> Mon, Sep 13, 2021 at 3:04 PM
To: TUSED/TUFED EDİTORÜ <editortused@gmail.com>

**Dear TUFED EDİTORÜ**

We have been trying hard to change according to the template. Our results have not been maximized because we have difficulty adjusting existing templates.

**Best Regards,**

**Binar Kurnia Prahani**
**Universitas Negeri Surabaya**

[Quoted text hidden]

**TUSED Template.12.03.2021 (1) (1).docx**
435K

# Summited Article (TUSED Covid-19: The Effects of Covid-19 on Science Education - Invitation to Submit Special Issue)

1 message

**Binar Kurnia Prahani** <binarprahani@unesa.ac.id> Tue, Oct 13, 2020 at 7:07 AM
To: editortused@gmail.com

Dr Binar Kurnia Prahani

Faculty of Mathematic and Natural Science

Surabaya State University *(Universitas Negeri Surabaya)*

Jl.  Ketintang Surabaya 60231, INDONESIA, 60213, Indonesia

binarprahani@unesa.ac.id

**Prof. Dr. Salih Çepni**

Editor-In-Chief, *Journal of Turkish Science Education*

Professor, Science Education, Bursa Uludag University, Turkey

October 13, 2020

Dear Prof. Dr. Salih Çepni

I am pleased to submit my paper entitled "Online Scientific Creativity Learning (OSCL) in Higher Education to Improve Students' Scientific Creativity in Covid-19 Pandemic" for consideration as an Original Article for *Journal of Turkish Science Education.*

**Abstract**
The Wademen Model was chosen to develop the Online Scientific Creativity Learning (OSCL). The quality of OSCL is measured using an expert validation sheet. Students' scientific creativity is assessed using the Scientific Creativity Test Instrument (SCTI) and then analyzed through N-gain and parametric inferential statistical tests. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. The OSCL can be an alternative for the scientific creativity of students in higher education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a learning innovation in higher education to improve students' scientific creativity in the Covid-19 pandemic.

**Keywords:** Covid-19 pandemic, higher education, learning innovation, OSCL, scientific creativity*.*

I confirm that this manuscript has not been previously published and is not currently under consideration by any other journal. Additionally, I have approved the contents of this paper and have agreed to *the Journal of Turkish Science Education*'s submission policies. To the best of my knowledge, I have no conflict of interest, financial or otherwise. Thank you very much.

Best Regards,

Dr Binar Kurnia Prahani

Corresponding Author

Faculty of Mathematics and Natural Science

Surabaya State University *(Universitas Negeri Surabaya)*

Jl.  Ketintang Surabaya 60231, INDONESIA, 60213, Indonesia

binarprahani@unesa.ac.id

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**2 attachments**

**Cover Letter_TUSED_Binar Kurnia Prahani.docx**
15K

**TUSED_Binar Kurnia Prahani et al.doc**
1136K

# Decision regarding your proposal for the special issue of TUSED: The Effects of Covid-19 on Science Education.

6 messages

**MERAL BEŞKEN ERGİŞİ** <mergisi@trabzon.edu.tr> Wed, Dec 2, 2020 at 6:37 PM
To: binarprahani@unesa.ac.id
Cc: AYŞEGÜL SAĞLAM ARSLAN <asaglam-arslan@trabzon.edu.tr>, Sri Rahayu <srirahayu_um@hotmail.com>

Dear Binar Kurnia Prahani,

As the editorial board of the special issue of TUSED: **The Effects of Covid-19 on Science Education,** we found your proposal "**Online Scientific Creativity Learning (OSCL) in Higher Education to Improve Students' Scientific Creativity in Covid-19 Pandemic**" quite exciting. However, it does not match with the scope of this special issue whose aim is to publish papers related to **'science education'.** Yet, the editorial board is willing to reconsider the proposal if it is linked to science education. You may send us a revised proposal in a week if you consider resubmitting it.

We are looking forward to hearing from you and please do not hesitate to contact us for any questions.

Best,

**Binar Kurnia Prahani** <binarprahani@unesa.ac.id> Fri, Dec 4, 2020 at 5:54 AM
To: MERAL BEŞKEN ERGİŞİ <mergisi@trabzon.edu.tr>

Dr Binar Kurnia Prahani

Faculty of Mathematic and Natural Science

Surabaya State University *(Universitas Negeri Surabaya)*

Jl. Ketintang Surabaya 60231, INDONESIA, 60213, Indonesia

binarprahani@unesa.ac.id

**Prof. Dr. Salih Çepni**

Editor-In-Chief, *Journal of Turkish Science Education*

Professor, Science Education, Bursa Uludag University, Turkey

**Prof. Dr. Meral BEŞKEN ERGİŞİ**

Trabzon Üniversitesi, Fatih Eğitim Fakültesi

December 04, 2020

**Dear Prof. Dr. Salih Çepni**

**Prof. Dr. Meral Beşken Ergişi**

I am pleased to submit my paper entitled "Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic" for consideration as an Original Article for *Journal of Turkish Science Education.*

Online Scientific Creativity Learning (OSCL) is an online learning model in higher education that emphasizes responsibility and scientific skills in enhancing students' scientific creativity. OSCL has 5 (five) online-based syntax, namely: Generating scientific creative, Organizing creative learning needs, Guiding the investigation, Establishing scientific creativity, Evaluation and Reflection. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at a moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at a low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. OSCL can be an alternative to the scientific creativity of students in science education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a science learning innovation to improve student scientific creativity in the Covid-19 pandemic. In addition, OSCL can be an alternative digital learning solution in the 4.0 industrial revolution. This research was only conducted on science (i.e. physics) learning and the sample was only 83 students at Universitas Lambung Mangkurat and Universitas Negeri Surabaya, Indonesia. For further research, it may be possible to research other level education and another subject.

I confirm that this manuscript has not been previously published and is not currently under consideration by any other journal. Additionally, I have approved the contents of this paper and have agreed to the *Journal of Turkish Science Education*'s submission policies. To the best of my knowledge, I have no conflict of interest, financial or otherwise.

**Best Regards,**

**Dr. Binar Kurnia Prahani**

Corresponding Author

Faculty of Mathematics and Natural Science

Surabaya State University *(Universitas Negeri Surabaya)*

Jl. Ketintang Surabaya 60231, INDONESIA, 60213, Indonesia

binarprahani@unesa.ac.id

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**3 attachments**

**Cover Letter_TUSED_Binar Kurnia Prahani.docx**
15K

**TUSED_Binar Kurnia Prahani et al rev.doc**
1142K

**Turnitin_TUSED_Binar Kurnia Prahani et al rev.pdf**
3570K

**MERAL BEŞKEN ERGİŞİ** <mergisi@trabzon.edu.tr> Fri, Dec 11, 2020 at 2:51 AM
To: Binar Kurnia Prahani <binarprahani@unesa.ac.id>

Dear **Dr. Binar Kurnia Prahani,**
Thank you for submitting your revised proposal. We will let you know about the decision ASAP.
Best,
Meral
[Quoted text hidden]

**Binar Kurnia Prahani** <binarprahani@unesa.ac.id> Fri, Dec 11, 2020 at 9:08 AM
To: MERAL BEŞKEN ERGİŞİ <mergisi@trabzon.edu.tr>

**Dear Prof. Dr. Meral BEŞKEN ERGİŞİ**

I confirm that this manuscript has never been published and is currently not being considered by any other journal. In addition, I have agreed to the contents of this paper and have agreed to the Turkish Journal of Science Education submission policy. To my knowledge, I have no conflict of interest, financial or otherwise. Hopefully, my article can be accepted at the Turkish Journal of Science Education. Thank you very much.

[Quoted text hidden]

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**MERAL BEŞKEN ERGİŞİ** <mergisi@trabzon.edu.tr> Fri, Dec 18, 2020 at 5:45 PM
To: Binar Kurnia Prahani <binarprahani@unesa.ac.id>

Dear Binar Kurnia Prahani,

We are pleased to inform you that your revised proposal is accepted for the special issue. We are looking forward to receiving your manuscript.

Best,
Meral, Ayşegül and Sri.

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<Cover Letter_TUSED_Binar Kurnia Prahani.docx><TUSED_Binar Kurnia Prahani et al rev.doc>
<Turnitin_TUSED_Binar Kurnia Prahani et al rev.pdf>

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**Binar Kurnia Prahani** <binarprahani@unesa.ac.id> Fri, Dec 18, 2020 at 6:14 PM
To: MERAL BEŞKEN ERGİŞİ <mergisi@trabzon.edu.tr>

**Dear Prof. Dr. Salih Çepni**
Editor-In-Chief, Journal of Turkish Science Education
Professor, Science Education, Bursa Uludag University, Turkey

**Prof. Dr. Meral BEŞKEN ERGİŞİ**
Trabzon Üniversitesi, Fatih Eğitim Fakültesi

Alhamdulillah. Thank you very much.
I have attached the article.

Do I need to be included in the OJS "Journal of Turkish Science Education"?

**Best Regards,**

**Binar Kurnia Prahani**
**Universitas Negeri Surabaya**

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**3 attachments**

**Cover Letter_TUSED_Binar Kurnia Prahani.docx**
15K

**Article_TUSED_Binar Kurnia Prahani et al rev.doc**
1142K

**Turnitin_TUSED_Binar Kurnia Prahani et al rev.pdf**
3570K

**TÜRK FEN EĞİTİMİ DERGİSİ**
**Yıl 12, Sayı 3, Eylül 2015**

**Journal of**
**TURKISH SCIENCE EDUCATION**
**Volume xx, Issue x, 2021**

http://www.tused.org

# Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic

Binar Kurnia PRAHANI[1], Nadi SUPRAPTO[2], Fida RACHMADIARTI[3], Arıf SHOLAHUDDIN[4], Saiyidah MAHTARI[5], SUYIDNO[6], Joko SISWANTO[7]

[1] Dr., Universitas Negeri Surabaya, Jl. Ketintang Surabaya 60231, INDONESIA, ORCID ID: https://orcid.org/0000-0002-5606-6629.
[2] Ph.D., CIQaR., CIQnR., Universitas Negeri Surabaya, Jl. Ketintang Surabaya 60231, INDONESIA, ORCID ID: https://orcid.org/0000-0002-8990-7412.
[3] Prof. Dr., Universitas Negeri Surabaya, Jl. Ketintang Surabaya 60231, INDONESIA, ORCID ID: https://orcid.org/0000-0002-0802-124X.
[4] Dr., Universitas Lambung Mangkurat Banjarmasin, Jl. Hasan Basry Banjarmasin 70123, INDONESIA, ORCID ID: https://orcid.org/0000-0002-6640-5479.
[5] M.Pd., Universitas Lambung Mangkurat Banjarmasin, Jl. Hasan Basry Banjarmasin 70123, INDONESIA, ORCID ID: https://orcid.org/0000-0002-5742-2381.
[6] Dr., Universitas Lambung Mangkurat Banjarmasin, Jl. Hasan Basry Banjarmasin 70123, INDONESIA, ORCID ID: https://orcid.org/0000-0002-3080-4267.
[7] Dr., Universitas PGRI Semarang, Jl. Sidodadi Timur Semarang, 50232, INDONESIA, ORCID ID: https://orcid.org/0000-0002-3655-9362.

**Received:** …. **Revised:** … **Accepted:** …

The original language of article is English (v.12, n.3, September 2015, pp.3-20, doi: 10.12973/tused.10143a)

**Reference:** Prahani, B. K., Suprapto, N., Rachmadiarti, F., Sholahuddin, A., Mahtari, S., Suyidno, & Siswanto, J. (2021). Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic. *Journal of Turkish Science Education*, xx (x), xx – xx.

## ABSTRACT

The Wademen Model was chosen to develop the Online Scientific Creativity Learning (OSCL). The quality of OSCL is measured using an expert validation sheet. Students' scientific creativity is assessed using the Scientific Creativity Test Instrument (SCTI) and then analyzed through N-gain and parametric inferential statistical tests. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. The OSCL can be an alternative for the scientific creativity of students in science education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a learning innovation in science education to improve students' scientific creativity in the Covid-19 pandemic.

**Keywords:** Covid-19 pandemic, higher education, learning innovation, OSCL, scientific creativity.

Correspondence author e-mail: binarprahani@unesa.ac.id

© ISSN: 1304-6020

## INTRODUCTION

Scientific creativity cannot be separated from a part of human life. Scientific creativity is very important to train students as a provision for success in the world of work (Pangastuti & Fadhillah, 2020; Suyidno et al., 2019; Zulkarnaen et al., 2017). Scientific creativity is skills to produce new ideas or new products that are relevant to the context and have scientific uses (Hu et al., 2010; Hu et al., 2013; Kang et al., 2015; Ozdemir & Dikici, 2017; Park, 2012; Raj & Saxena, 2016; Zainuddin et al. 2020). Therefore, educators are obliged to train scientific creativity so that students can be successful. However, the results of preliminary found that the students' scientific creativity in physics at the Universitas Negeri Surabaya (i.e. Indonesia) was still low. Low scientific creativity is caused by conventional and monotonous learning which tends only to conceptualize and manage routine problems, as well as scientific activities through experiments (Zainuddin et al. 2020). The research results of Suyidno, Dewantara, Nur, & Yuanita (2017), which show the need to improve scientific investigation by optimizing scientific process skills in constructing knowledge and increasing the scientific creativity of students.

The low level of high-order thinking skills (i.e. scientific creativity) of students has something to do with the learning process used. The conventional learning, is less able to facilitate learning, resulting in low learning achievement including low scientific creativity (Hammond et al., 2015; Jatmiko et al., 2016). Therefore, to improve the quality of learning to facilitate the improvement of students' scientific creativity, among others is by implementing Creative Responsibility Based Learning (CRBL). Creativity Responsibility Based Learning (CRBL) is a creative learning model that optimum responsibility of student in the success of scientific investigations and scientific creativity tasks (Suyidno et al., 2019; Suyidno et al., 2017). The results showed that CRBL was effective in increasing scientific creativity, science process skills, and responsibility (Suyidno et al., 2019; Suyidno et al., 2017). However, CRBL has been implemented through face-to-face learning.

The problem that arises in 2020 is that in Indonesia, learning has shifted to online learning (Abidah et al., 2020; Famularsih, 2020). The cause is the Covid-19 pandemic. The increasing development of Covid-19 virus cases in Indonesia has prompted working and doing activities from home or Work From Home (WFH). This policy from the government has been responded positively by the Universitas Negeri Surabaya by issuing several policies related to lectures on campus, one of the important core contents is that face-to-face lectures are eliminated and replaced by online lectures and continue to study at home. This is not only positive, but still creates new problems, namely that not all students and lecturers are ready for online learning. Besides, students' scientific creativity also needs to be improved, but students must stay at home because face-to-face lectures are eliminated and replaced by online. It is necessary to find a solution point for solving the problem so that there is no decrease in the quality of student graduates, including scientific creativity. Therefore, alternative solutions in this research aim to produce an effective Online Scientific Creativity Learning (OSCL) to increase students' scientific creativity. This alternative solution has never been done in previous research at the regional, national, and international levels. Another positive side is the existence of new innovative outputs that can be an alternative solution in the era of the Covid-19 pandemic.

## LITERATURE REVIEW

### Scientific Creativity

Students try to engage at every stage of creativity when they perceive some deficiency or mismatch, tension, or stimulation. The habit of avoiding the usual solutions by investigating, diagnosing, manipulating, making guesses and testing hunches, modifying and retesting until they find the desired solution (Al-khatib, 2012; Blascova, 2014; Cocu et al., 2015; Didin & Wiji, 2020; Gregory et al., 2013; Laisema & Wannapiroon, 2014; Saliceti, 2015; Yusnaeni et al., 2017; Zubaidah et al., 2017). Scientific creativity is emphasized on indicators of determining the usefulness of objects for scientific purposes, finding scientific problems, increasing the usefulness of a product technically, imagining scientifically, designing creative experiments, solving scientific problems creatively, and designing products creatively (Hu & Adey, 2010; Astutik et al., 2020; Chin & Siew, 2015; Florence et al., 2015; Rizqi et al., 2020; Usta & Akkanat, 2015; Zainuddin et al 2020). Very important to increase students' scientific creativity in the process of Covid-19 pandemic. In terms of scientific creativity, researchers began working toward developing a vaccine against this novel coronavirus as soon as its genetic sequence became available in February 2020 (Kapoor & Kaufman, 2020; Ren et al., 2020). The improvement of scientific creativity in the science (i.e. physics) learning process can be done through: (a) scientific investigation, involving scientific process skills in scientific investigation activities; (b) understanding, involving students in understanding knowledge creatively; (c) presentations, involving students in building their knowledge through the delivery of ideas and sharing creative ideas with others; (d) application, facilitating students to find new ways of explaining scientific phenomena, making predictions, solving problems, and stating or implying what is not known; and (e) transformation, students are allowed to propose changes based on their knowledge and thoughts (Daud et al., 2012; Dhir, 2014; Kadayifci, 2017; OECD, 2014; Zainuddin et al 2020).

## Online Scientific Creativity Learning (OSCL)

OSCL is an online learning model that emphasizes responsibility and scientific skills in enhancing scientific creativity. The development of the learning process in the OSCL based on the scientific creativity hypothesis (Hu & Adey, 2010), and the latest learning theories: constructivism theory, complex cognitive processes, advanced organizer, and scaffolding (Arends, 2012; Eggen & Kauchak, 2013; Solso et al., 2008). OSCL was developed with the main aim of enhancing students' scientific creativity. OSCL has 5 (five) online-based syntax, namely: Generating scientific creative, Organizing creative learning needs, Guiding the investigation, Establishing scientific creativity, Evaluation and Reflection.

**Table 1:** Activities of OSCL using ZOOM platform

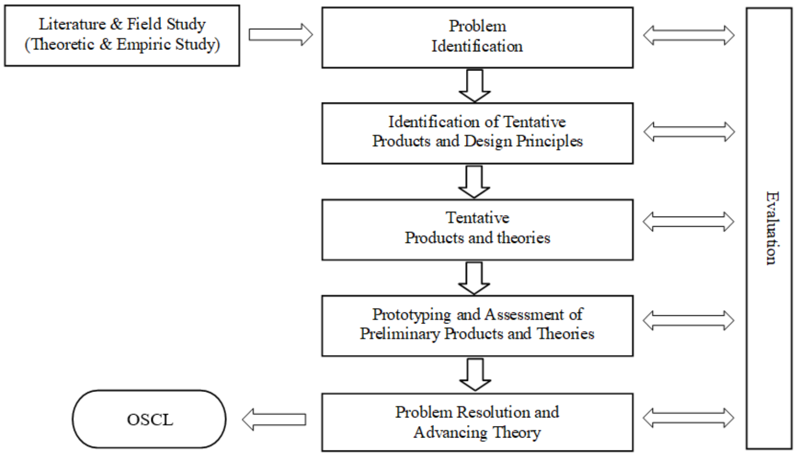
| **Activities of OSCL** |
|---|
| **Phase 1: Generating scientific creative (± 10 minutes)**<br>1. The lecturer opens the lesson by saying greetings then checks the attendance of students through the ZOOM application.<br>2. Flipped learning requires students to learn teaching materials at home independently before learning to use ZOOM.<br>3. Through the ZOOM application, the lecturer motivates by asking students to imagine or think outside the box to mention as many scientific uses as possible.<br>4. Through the ZOOM application, lecturers convey learning objectives, then remind that a sense of responsibility can generate imagination and courage to be more open to new, more creative ideas. |
| **Phase 2: Organizing creative learning needs (± 10 minutes)**<br>1. Through the ZOOM application, lecturers guide students in understanding science process skills, the need for tools and materials, as well as the PhET media for experiments referring to student activity sheets.<br>2. Through the ZOOM application, lecturers ask students to actively participate and ensure that they have teaching materials and student activity sheets and logistics. |
| **Phase 3: Guiding the investigation (± 60 minutes)**<br>Through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets (containing indicators of scientific creativity) includes:<br>1. Write down as many problem formulations as possible to investigate and isolate the problems to be selected for investigation.<br>2. Planning experiments. |

| Activities of OSCL |
|---|
| 3. Carry out the best possible experiment to get the correct data.<br>4. Analyze data and study various reference sources, especially teaching materials to find solutions to problems you want to solve accurately and deeply. |
| **Phase 4: Establishing scientific creativity (± 60 minutes)**<br>Through the ZOOM application, the lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks as follows:<br>1. Through the ZOOM application, the lecturer guides students in the best possible presentation of the ZOOM and asks students to give suggestions to other students who are presenting.<br>2. Through the ZOOM application, lecturers help students discuss material and examples of problems in teaching materials, especially those that are not yet understood. |
| **Phase 5: Evaluation and Reflection (± 10 Minutes)**<br>1. Through the ZOOM application, the lecturer evaluates the scientific creativity and reflecting on their responsibilities during the process of learning.<br>2. Through the ZOOM application, the lecturer asks students to work on an assessment sheet (if there is insufficient time, it can be continued independently).<br>3. Through the ZOOM application, the lecturer reminds students to re-learn materials for the next meeting. |

The reasons why these activities were used (See Table 1) are adapting activities from CRBL that have been proven valid, practical and effective to increase scientific creativity (Suyidno et al, 2018). However, there are fundamental differences in OSCL, namely science learning carried out using ZOOM and during the Covid-19 pandemic, this has not been used in the implementation of CRBL. Table 1 describes the five phases of OSCL. OSCL was specifically developed to increase students' scientific creativity in science learning during the Covid-19 pandemic. In phase 1 (Generating scientific creative) has two points activities: (1) the lecturer motivates by asking students to imagine or think outside the box to mention as many scientific uses as possible; (2) Through the ZOOM application, lecturers convey learning objectives, then remind that a sense of responsibility can generate imagination and courage to be more open to new, more creative ideas. This phase focus to train the indicators of scientific creativity such as Unusual Uses and Scientific Imagination. In phase 2 (Organizing creative learning needs) focus to prepare the indicators of scientific creativity such as Creatively Experiment Designing, Science Creatively Problem Solving, and Creatively Product Design. In phase 3 (Guiding the investigation) through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets. This phase focus to train the indicators of scientific creativity such as Unusual Uses, Problem Finding, Product Improvement, Scientific Imagination, Creatively Experiment Designing, Science Creatively Problem Solving, Creatively Product Design. In phase 4 (Establishing scientific creativity) focus to improve the students' scientific creativity through the ZOOM application. The lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks. In phase 5 (Evaluation and Reflection) through the ZOOM application, the lecturer evaluates the scientific creativity and reflecting on their responsibilities during the process of learning.

## METHODS

This research is an educational design research. The Wademen model was chosen to develop the OSCL (Plomp, 2013) with modifications including 1) problem systems, 2) tentative product and design principles, 3) tentative theory and products, 4) prototyping, and assessing products, and 5) improve product quality. Wademan's model was chosen because this model has advantages in terms of practicality and effectiveness to develop an innovative model that is novelty and state of the art. Besides, researchers also developed OSCL-based learning tools (Plomp, 2013) presented in Figure 1.



(Adaptation: Wademan in Plomp, 2013)

**Figure 1:** Stages of Wademan model development (modification)

Populations were taken from 210 students at Universitas Negeri Surabaya dan Universitas Lambung Mangkurat, Indonesia based on the Slovin formula (Sevilla et al., 1984). Sample of this research was conducted in 3 groups, namely OSCL (29 Student of Universitas Negeri Surabaya), CRBL (25 Student of Universitas Lambung Mangkurat), and Conventional Learning (29 Student of Universitas Negeri Surabaya), where these three groups are homogeneous. True Experiment with Randomized Subject Control-group Pre-test and Post-test Design is used in this research (Fraenkel et al., 2012).

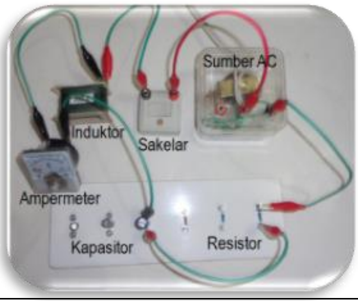
| | | |
|---|---|---|
| $T_1$ | $E_1$ | $T_2$ |
| $T_1$ | $E_2$ | $T_2$ |
| $T_1$ | C | $T_2$ |

With = $T_1$: Pre-test, $T_2$: Post-test, $E_1$: OSCL, $E_2$: CRBL and C: Conventional Learning

This research aims to produce an Online Scientific Creativity Learning (OSCL) for improving the students' scientific creativity in the Covid-19 pandemic. Apart from looking for the validity of the OSCL, this research also emphasizes the analysis of the effectiveness of OSCL, CRBL, and conventional learning. The quality of the OSCL learning tool was assessed by 2 experts using a validation sheet. Scientific creativity of students is measured using the Scientific Creativity Test instrument (SCTI) detailed in Table 2 and then analyzed through the homogeneity test, normality test, Paired t-test, N-gain (Hake, 1998), and Independent t-test.

**Table 2:** Scientific Creativity Test Instrument (SCTI)

| **Scientific Creativity Test Instrument (SCTI)** | |
|---|---|
| Problem 1:<br>Unusual Uses | You are given three minutes.<br>List as many scientific uses of a capacitor as you can think of. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 2:<br>Problem Finding | You are given five minutes.<br>Imagine a Philips lamp with power P connected to an AC source state power plant (i.e. PLN) and an inductor. The maximum amount of electric current flowing in the circuit is $I_{maks} = \frac{V_{maks}}{\sqrt{R_{Lampu}^2 + X_L^2}}$, where $R_{Lamp} = \frac{P_{in\ lamp}}{V_{in\ lamp}^2}$. Write down as many problem formulas as you want for research. Don't stop writing until you are asked to stop. When |

| Scientific Creativity Test Instrument (SCTI) | |
|---|---|
| | asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 3: Product Improvement | You are given three minutes.<br>List the possible repairs to an LCD (Liquid Crystal Display) projector so that It is easier to repair if it gets damaged. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 4: Scientific Imagination | You are given three minutes.<br>Integrated Circuit (IC) is a combination of active and passive electronic components including hundreds or even millions of resistors and capacitors which are integrated into an electronic circuit in a small package. Imagine if IC has been used widely in everyday life, what would happen in this life! Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 5: Creatively Experiment Designing | You are given ten minutes.<br>Two inductors that are identical but different in shape are provided. Write an experimental plan to test which inductor is better? Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 6: Science Creatively Problem Solving | You are given five minutes.<br>Provided electronic components in the form of a reading lamp, inductor, capacitor, resistor, slide switch, and AC / DC source. Draw as many sequences as possible to make the reading light more versatile. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 7: Creatively Product Design | You are given ten minutes. Look at the test image of the RLC series below!<br><br>Describe a more secure and attractive experimental design of the RLC series circuit, then show the name and function of each part! Don't stop designing until you're asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |

(Ayas & Sak, 2014; Hu & Adey, 2010; Mukhopadhyay & Sen, 2013; Serway & Jewett, 2014; Siew et al., 2014; Suyidno et al., 2017; Walker et al., 2014)

To support the use of the SCTI, an assessment rubric was made. Rubric for assessing scientific creativity in this research is presented in Table 3.

**Table 3:** Rubric for assessing scientific creativity

| **Indicators of Scientific Creativity** | **Dimensions of Creativity** | **Criteria** |
|---|---|---|
| 1. Unusual uses<br>2. Problem finding<br>3. Product improvement<br>4. Scientific imagination<br>5. Science creatively problem solving | Fluency | Count all correct responses given. Each correct response is given a score of 1. |
| | Flexibility | Counts the number of correct approaches given. |
| | Originality | Tabulates the frequency of all the correct responses. The frequency and percentage of each response is calculated and the one with the smallest probability of response is chosen. If the response probability is less than 5%, the score is 2; if the probability of 5 to 10% is given a score of 1; if the response probability is greater than 10% it is given a score of 0. |
| 6. Creatively experiment designing | Originality | |
| | Flexibility | Counts the number of correct approaches given. |
| 7. Creatively product design | Originality | Give a score of 1 to 5 based on a holistic assessment. |
| | Flexibility | Each correct function is assigned a score of 1. |

## FINDINGS

### Validation Results

**Table 4:** The validity and reliability result of learning material and research instruments

| Components | Construct Validity | | Content Validity | |
|---|---|---|---|---|
| Online Lesson Plan of OSCL | Valid | Reliable | Valid | Reliable |
| Student Worksheet of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Student Learning Materials of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Online Learning Materials of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Scientific Creativity Test Instrument (SCTI) | Valid | Reliable | Valid | Reliable |

Table 4 shows that OSCL Quality, Learning Materials, and Research Instruments which is reviewed from the aspects of construct validity and content validity are categorized as valid and reliable. The validity and reliability result of learning material and research instruments must be fulfilled. This is a prerequisite for the development research carried out in this research. The validation process was carried out on 2 science education experts in higher education. these two experts assessed the quality of the tools and instruments developed by the researchers. The validation results are presented in Table 4. These results are used as the basis for continuing at the implementation stage.

## Scientific Creativity

The results of student scientific creativity using OSCL, CRBL, and Conventional Learning were analyzed in the form of pre-test, posttest, and N-gain including each indicator of scientific creativity are presented in Table 5.

**Table 5.** The results of scientific creativity score

| Group | Scores | Scientific Creativity Indicator | | | | | | | Scientific Creativity |
|---|---|---|---|---|---|---|---|---|---|
| | | Unusua Uses | Problem Finding | Product Improvement | Scientific Imagination | Creatively Experiment Designing | Science Creatively Problem Solving | Creatively Product Design | |
| 1 (OSCL) | Pre-test | 1,91 | 0,03 | 1,76 | 1,71 | 0,14 | 1,80 | 1,42 | 1,25 |
| | Post-test | 2,75 | 3,01 | 2,77 | 2,91 | 2,56 | 2,86 | 2,43 | 2,76 |
| | N-gain | **0,40** | **0,75** | **0,45** | **0,52** | **0,63** | **0,48** | **0,39** | **0,55** |
| 2 (CRBL) | Pre-test | 1,15 | 0,59 | 1,20 | 1,26 | 0,56 | 1,59 | 2,01 | 1,19 |
| | Post-test | 2,72 | 2,06 | 2,96 | 2,59 | 2,72 | 2,94 | 3,16 | 2,74 |
| | N-gain | **0,55** | **0,43** | **0,63** | **0,49** | **0,63** | **0,56** | **0,58** | **0,55** |
| 3 (Conventional Learning) | Pre-test | 1,91 | 0,03 | 1,76 | 1,71 | 0,14 | 1,80 | 1,42 | 1,25 |
| | Post-test | 1,93 | 0,05 | 1,84 | 1,73 | 0,17 | 1,91 | 1,45 | 1,30 |
| | N-gain | **0,01** | **0,01** | **0,04** | **0,01** | **0,01** | **0,05** | **0,01** | **0,02** |

The results of students' scientific creativity using OSCL, CRBL, and Conventional Learning were carried out by parametric inferential statistical analysis (because the data met the requirements of homogeneity and were normally distributed) are presented in Table 6.

**Table 6:** Paired t-test of scientific creativity owned by students

| Group | N | Paired t-test | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std, error mean | T | df | p |
| 1 (OSCL) | 29 | -1,50 | 0,35 | -22,86 | 28 | 0,00 |
| 2 (CRBL) | 25 | -1,54 | 0,43 | -17,98 | 24 | 0,00 |
| 3 (Conventional Learning) | 29 | - 0,05 | 0,13 | -1,95 | 28 | 0,00 |

To find out more effective learning between OSCL, CRBL, and Conventional Learning in increasing (N-Gain) scientific creativity, it was tested using the Independent T-Test are presented in Table 7.

**Table 7:** Independent t-test of scientific creativity

| Group (N-gain) | N | Independent t-test | | | | |
|---|---|---|---|---|---|---|
| | | Mean Difference | Std. error mean | t | df | p |
| 1 (OSCL) & 2 (CRBL) | 54 | 0,01 | 0,03 | 0,19 | 52 | 0,84 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 (OSCL) & 3 (Conventional Learning) | 58 | 0,53 | 0,02 | 23,17 | 56 | 0,00 |
| 2 (CRBL) & 3 (Conventional Learning) | 54 | 0,52 | 0,02 | 22,70 | 52 | 0,00 |

## DISCUSSION

The OSCL learning device has been proven valid and reliable (i.e. Table 4) consist of: Online Lesson Plan of OSCL; Student Worksheet of Scientific Creativity; Student Learning Materials of Scientific Creativity; Online Learning Materials of Scientific Creativity. In addition, The OSCL learning device has also been declared as novelty by the validators. OSCL learning devices meet the latest needs during the Covid-19 pandemic, which is to provide online-based learning tools that can be used in distance learning in the Universitas Negeri Surabaya. Another positive result is a learning device that is declared valid and reliable device can support OSCL implementation to increase students' scientific creativity. It is proven in Tables 5 and 6 that there is an improvement in scientific creativity of students. The results of this research are supported by the research findings of Dwikoranto et al. (2020), Pandiangan et al. (2017), Susantini et al. (2017), Susantini et al. (2016) stated that valid learning tools can improve learning outcomes.

Table 5 explains that in all groups (OSCL, CRBL, Conventional Learning) students' scientific creativity before learning is at a low level. The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. Implementation of OSCL to improve scientific creativity in phase 3: Guiding the investigation (OSCL); through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets (containing indicators of scientific creativity) includes: (1) Write down as many problem formulations as possible to investigate and isolate the problems to be selected for investigation; (2) Planning experiments; (3) Carry out the best possible experiment to get the correct data; (4) Analyze data and study various reference sources, especially teaching materials to find solutions to problems you want to solve accurately and deeply. In phase 3 (Guiding the investigation) through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets. This phase focus to train the indicators of scientific creativity such as Unusual Uses, Problem Finding, Product Improvement, Scientific Imagination, Creatively Experiment Designging, Science Creatively Problem Solving, Creatively Product Design. Phase 3 (OSCL) focuses on scientific investigation activities that are relevant to the research of Khan & Alotaibi, 2020; Mamun et al., 2020; Novo-corti, et al., 2013; Widodo et al., 2016; Yigit et al., 2014 found that investigations will activate students' scientific skills. In this third phase students are strengthened by scientific creativity through investigations using a virtual lab. This is perfect for online learning in the Covid-19 pandemic. Students and lecturers do not meet directly, but through the Zoom application. This can also reduce the transmission and spread of Covid-19, which until this article was written (19/10/2020) positive conditions in Indonesia are still increasing. Imagine if learning and experiments were forced using face to face, where students interacted directly and often students did not comply with the Covid-19 health protocol. The impact that will occur is a positive increase in the environment of the Universitas Negeri Surabaya and Universitas Lambung Mangkurat (research sites). The results of the latest research during the Covid-19 pandemic by Suryaman et al (2020) & Saputro et al (2020) stated that students responded positively to the experiment virtually during the Covid-19 pandemic.

The novelty of OSCL to increase scientific creativity through online learning in addition to phase 3 are also included in phase 4: Establishing scientific creativity (OSCL). Through the ZOOM application, the lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks as follows: (1) Through the ZOOM application, the lecturer guides students in the best possible presentation of the ZOOM and asks students to give suggestions to other students who are presenting, (2) Through the ZOOM application, lecturers help students discuss material and examples of problems in teaching materials, especially those that are not yet understood. In phase 4 (Establishing scientific creativity) focus to improve the students' scientific creativity through the ZOOM application. The lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks. This shows that after treatment in the OSCL and CRBL models it can improve scientific creativity (High level), while in Conventional Learning it is still at a low level. More specifically, OSCL (2.76 in high level) and CRBL (2.74 in high level). This shows that OSCL can be used to enhance scientific creativity. This finding is following the results of previous research (Suyidno et al., 2017; Zulkarnaen et al., 2017) that learning based on a valid scientific approach can increase students' scientific creativity. Besides, there is another support from the application of Vygotsky's scaffolding learning theory that students will be successful if they receive gradual guidance from lecturers through social learning.

Table 6 has shown that there is the same significance (N-gain at a moderate level) between OSCL and Creativity-Based Responsibility Based Learning (CRBL), except with conventional learning (N-gain at a low level). The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. It is a novelty that OSCL can accommodate CRBL weaknesses that require face-to-face meetings to enhance scientific creativity. By using OSCL, lecturers can increase students' scientific creativity through online learning. The findings of this study are supported by Wicaksono et al. (2017) Virtual-based scientific learning can for improving the students' scientific creativity. The effectiveness of OSCL as online learning is also covered by the dual coding theory that learning using multiple representations will provide more experience than to students compared to conventional learning (Siswanto et al., 2018; Siswanto et al., 2018).

## CONCLUSION

OSCL is an online science learning model that emphasizes responsibility and scientific skills in enhancing scientific creativity. OSCL has 5 (five) online-based syntax, namely: Generating scientific creative, Organizing creative learning needs, Guiding the investigation, Establishing scientific creativity, Evaluation and Reflection. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. OSCL can be an alternative for the scientific creativity of students in science education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a science learning innovation to improve student scientific creativity in the Covid-19 pandemic. In addition, OSCL can be an alternative digital learning solution in the science education. The limitation of this research, it was only conducted on science (i.e. physics) learning and the sample was only 83 students at Universitas Lambung Mangkurat and Universitas Negeri Surabaya, Indonesia. For further research: (1) OSCL can be applied to science education with other levels of education such as elementary school, junior high school and senior high school, (2) OSCL research based gender at the elementary school, junior high school and senior high school and higher education, and (3) applying OSCL to increase students' motivation in science education.

## ACKNOWLEDGMENT

Researchers would like to thank Civitas Academic of Universitas Lambung Mangkurat, and Universitas Negeri Surabaya, and Universitas PGRI Semarang for supporting this collaborative research during the Covid-19 pandemic. Especially to Assoc. Prof. Dr. Sri Astutik and Assoc. Prof. Dr. Dwikoranto for providing advice on quality science learning tools. In addition, researchers appreciate the editorial board and reviewers at Journal of Turkish Science Education (TUSED) who have provided suggestions for improving the quality of our articles.

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TÜRK FEN EĞİTİMİ DERGİSİ
Yıl 12, Sayı 3, Eylül 2015

Journal of
TURKISH SCIENCE EDUCATION
Volume 18, Issue 2, June 2021

http://www.tused.org

# Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic

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**Received:** …. **Revised:** … **Accepted:** …

The original language of article is English (v.12, n.3, September 2015, pp.3-20, doi: 10.12973/tused.10143a)

**Reference:** Prahani, B. K., Suprapto, N., Rachmadiarti, F., Sholahuddin, A., Mahtari, S., Suyidno, & Siswanto, J. (2021). Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic. *Journal of Turkish Science Education*, 18 (2), 1 – 13.

## ABSTRACT

The Wademen Model was chosen to develop the Online Scientific Creativity Learning (OSCL). The quality of OSCL is measured using an expert validation sheet. Students' scientific creativity is assessed using the Scientific Creativity Test Instrument (SCTI) and then analyzed through N-gain and parametric inferential statistical tests. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. The OSCL can be an alternative for the scientific creativity of students in science education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a learning innovation in science education to improve students' scientific creativity in the Covid-19 pandemic.

**Keywords:** Covid-19 pandemic, higher education, learning innovation, OSCL, scientific creativity.

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© ISSN: 1304-6020

## INTRODUCTION

Scientific creativity cannot be separated from a part of human life. Scientific creativity is very important to train students as a provision for success in the world of work (Pangastuti & Fadhillah, 2020; Suyidno et al., 2019; Zulkarnaen et al., 2017). Scientific creativity is skills to produce new ideas or new products that are relevant to the context and have scientific uses (Hu et al., 2010; Hu et al., 2013; Kang et al., 2015; Ozdemir & Dikici, 2017; Park, 2012; Raj & Saxena, 2016; Zainuddin et al. 2020). Therefore, educators are obliged to train scientific creativity so that students can be successful. However, the results of preliminary found that the students' scientific creativity in physics at the Universitas Negeri Surabaya (i.e. Indonesia) was still low. Low scientific creativity is caused by conventional and monotonous learning which tends only to conceptualize and manage routine problems, as well as scientific activities through experiments (Zainuddin et al. 2020). The research results of Suyidno, Dewantara, Nur, & Yuanita (2017), which show the need to improve scientific investigation by optimizing scientific process skills in constructing knowledge and increasing the scientific creativity of students.

The low level of high-order thinking skills (i.e. scientific creativity) of students has something to do with the learning process used. The conventional learning, is less able to facilitate learning, resulting in low learning achievement including low scientific creativity (Hammond et al., 2015; Jatmiko et al., 2016). Therefore, to improve the quality of learning to facilitate the improvement of students' scientific creativity, among others is by implementing Creative Responsibility Based Learning (CRBL). Creativity Responsibility Based Learning (CRBL) is a creative learning model that optimum responsibility of student in the success of scientific investigations and scientific creativity tasks (Suyidno et al., 2019; Suyidno et al., 2017). The results showed that CRBL was effective in increasing scientific creativity, science process skills, and responsibility (Suyidno et al., 2019; Suyidno et al., 2017). However, CRBL has been implemented through face-to-face learning.

The problem that arises in 2020 is that in Indonesia, learning has shifted to online learning (Abidah et al., 2020; Famularsih, 2020). The cause is the Covid-19 pandemic. The increasing development of Covid-19 virus cases in Indonesia has prompted working and doing activities from home or Work From Home (WFH). This policy from the government has been responded positively by the Universitas Negeri Surabaya by issuing several policies related to lectures on campus, one of the important core contents is that face-to-face lectures are eliminated and replaced by online lectures and continue to study at home. This is not only positive, but still creates new problems, namely that not all students and lecturers are ready for online learning. Besides, students' scientific creativity also needs to be improved, but students must stay at home because face-to-face lectures are eliminated and replaced by online. It is necessary to find a solution point for solving the problem so that there is no decrease in the quality of student graduates, including scientific creativity. Therefore, alternative solutions in this research aim to produce an effective Online Scientific Creativity Learning (OSCL) to increase students' scientific creativity. This alternative solution has never been done in previous research at the regional, national, and international levels. Another positive side is the existence of new innovative outputs that can be an alternative solution in the era of the Covid-19 pandemic.

## LITERATURE REVIEW

### Scientific Creativity

Students try to engage at every stage of creativity when they perceive some deficiency or mismatch, tension, or stimulation. The habit of avoiding the usual solutions by investigating, diagnosing, manipulating, making guesses and testing hunches, modifying and retesting until they find the desired solution (Al-khatib, 2012; Blascova, 2014; Cocu et al., 2015; Didin & Wiji, 2020; Gregory et al., 2013; Laisema & Wannapiroon, 2014; Saliceti, 2015; Yusnaeni et al., 2017; Zubaidah et al., 2017). Scientific creativity is emphasized on indicators of determining the usefulness of objects for scientific purposes, finding scientific problems, increasing the usefulness of a product technically, imagining scientifically, designing creative experiments, solving scientific problems creatively, and designing products creatively (Hu & Adey, 2010; Astutik et al., 2020; Chin & Siew, 2015; Florence et al., 2015; Rizqi et al., 2020; Usta & Akkanat, 2015; Zainuddin et al 2020). Very important to increase students' scientific creativity in the process of Covid-19 pandemic. In terms of scientific creativity, researchers began working toward developing a vaccine against this novel coronavirus as soon as its genetic sequence became available in February 2020 (Kapoor & Kaufman, 2020; Ren et al., 2020). The improvement of scientific creativity in the science (i.e. physics) learning process can be done through: (a) scientific investigation, involving scientific process skills in scientific investigation activities; (b) understanding, involving students in understanding knowledge creatively; (c) presentations, involving students in building their knowledge through the delivery of ideas and sharing creative ideas with others; (d) application, facilitating students to find new ways of explaining scientific phenomena, making predictions, solving problems, and stating or implying what is not known; and (e) transformation, students are allowed to propose changes based on their knowledge and thoughts (Daud et al., 2012; Dhir, 2014; Kadayifci, 2017; OECD, 2014; Zainuddin et al 2020).

**Online Scientific Creativity Learning (OSCL)**

OSCL is an online learning model that emphasizes responsibility and scientific skills in enhancing scientific creativity. The development of the learning process in the OSCL based on the scientific creativity hypothesis (Hu & Adey, 2010), and the latest learning theories: constructivism theory, complex cognitive processes, advanced organizer, and scaffolding (Arends, 2012; Eggen & Kauchak, 2013; Solso et al., 2008). OSCL was developed with the main aim of enhancing students' scientific creativity. OSCL has 5 (five) online-based syntax, namely: Generating scientific creative, Organizing creative learning needs, Guiding the investigation, Establishing scientific creativity, Evaluation and Reflection.

**Table 1:** Activities of OSCL using ZOOM platform

| Activities of OSCL |
|---|
| **Phase 1: Generating scientific creative (± 10 minutes)**<br>1. The lecturer opens the lesson by saying greetings then checks the attendance of students through the ZOOM application.<br>2. Flipped learning requires students to learn teaching materials at home independently before learning to use ZOOM.<br>3. Through the ZOOM application, the lecturer motivates by asking students to imagine or think outside the box to mention as many scientific uses as possible.<br>4. Through the ZOOM application, lecturers convey learning objectives, then remind that a sense of responsibility can generate imagination and courage to be more open to new, more creative ideas. |
| **Phase 2: Organizing creative learning needs (± 10 minutes)**<br>1. Through the ZOOM application, lecturers guide students in understanding science process skills, the need for tools and materials, as well as the PhET media for experiments referring to student activity sheets.<br>2. Through the ZOOM application, lecturers ask students to actively participate and ensure that they have teaching materials and student activity sheets and logistics. |
| **Phase 3: Guiding the investigation (± 60 minutes)**<br>Through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets (containing indicators of scientific creativity) includes:<br>1. Write down as many problem formulations as possible to investigate and isolate the problems to be selected for investigation.<br>2. Planning experiments. |

| Activities of OSCL |
| --- |
| 3. Carry out the best possible experiment to get the correct data.<br>4. Analyze data and study various reference sources, especially teaching materials to find solutions to problems you want to solve accurately and deeply. |
| **Phase 4: Establishing scientific creativity (± 60 minutes)**<br>Through the ZOOM application, the lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks as follows:<br>1. Through the ZOOM application, the lecturer guides students in the best possible presentation of the ZOOM and asks students to give suggestions to other students who are presenting.<br>2. Through the ZOOM application, lecturers help students discuss material and examples of problems in teaching materials, especially those that are not yet understood. |
| **Phase 5: Evaluation and Reflection (± 10 Minutes)**<br>1. Through the ZOOM application, the lecturer evaluates the scientific creativity and reflecting on their responsibilities during the process of learning.<br>2. Through the ZOOM application, the lecturer asks students to work on an assessment sheet (if there is insufficient time, it can be continued independently).<br>3. Through the ZOOM application, the lecturer reminds students to re-learn materials for the next meeting. |

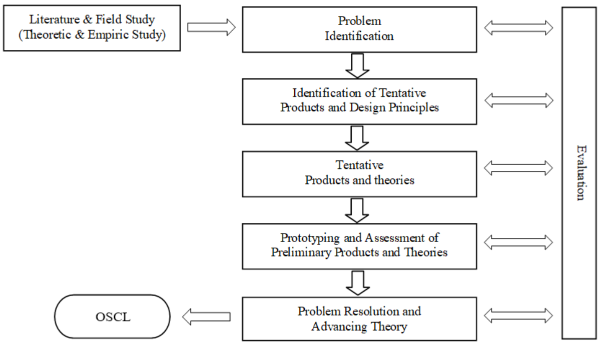
The reasons why these activities were used (See Table 1) are adapting activities from CRBL that have been proven valid, practical and effective to increase scientific creativity (Suyidno et al, 2018). However, there are fundamental differences in OSCL, namely science learning carried out using ZOOM and during the Covid-19 pandemic, this has not been used in the implementation of CRBL. Table 1 describes the five phases of OSCL. OSCL was specifically developed to increase students' scientific creativity in science learning during the Covid-19 pandemic. In phase 1 (Generating scientific creative) has two points activities: (1) the lecturer motivates by asking students to imagine or think outside the box to mention as many scientific uses as possible; (2) Through the ZOOM application, lecturers convey learning objectives, then remind that a sense of responsibility can generate imagination and courage to be more open to new, more creative ideas. This phase focus to train the indicators of scientific creativity such as Unusual Uses and Scientific Imagination. In phase 2 (Organizing creative learning needs) focus to prepare the indicators of scientific creativity such as Creatively Experiment Designing, Science Creatively Problem Solving, and Creatively Product Design. In phase 3 (Guiding the investigation) through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets. This phase focus to train the indicators of scientific creativity such as Unusual Uses, Problem Finding, Product Improvement, Scientific Imagination, Creatively Experiment Designing, Science Creatively Problem Solving, Creatively Product Design. In phase 4 (Establishing scientific creativity) focus to improve the students' scientific creativity through the ZOOM application. The lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks. In phase 5 (Evaluation and Reflection) through the ZOOM application, the lecturer evaluates the scientific creativity and reflecting on their responsibilities during the process of learning.

## METHODS

This research is an educational design research. The Wademen model was chosen to develop the OSCL (Plomp, 2007) with modifications including 1) problem systems, 2) tentative product and design principles, 3) tentative theory and products, 4) prototyping, and assessing products, and 5) improve product quality. Wademan's model was chosen because

**Commented [SR1]:** Check accuracy. Is there Wademan model in Plomp,(2013) as written in the references?

this model has advantages in terms of practicality and effectiveness to develop an innovative model that is novelty and state of the art. Besides, researchers also developed OSCL-based learning tools presented in Figure 1.




(Adaptation: Wademan in Plomp, 2007)

**Figure 1:** Stages of Wademan model development (modification)

Populations were taken from 210 students at Universitas Negeri Surabaya dan Universitas Lambung Mangkurat, Indonesia based on the Slovin formula (Sevilla et al., 1984). Sample of this research was conducted in 3 groups, namely OSCL (29 Student of Universitas Negeri Surabaya), CRBL (25 Student of Universitas Lambung Mangkurat), and Conventional Learning (29 Student of Universitas Negeri Surabaya), where these three groups are homogeneous. True Experiment with Randomized Subject Control-group Pre-test and Post-test Design is used in this research (Fraenkel et al., 2012).

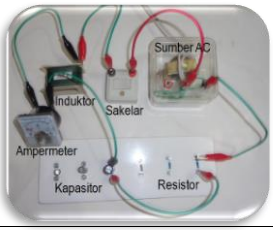
| | | |
|---|---|---|
| $T_1$ | $E_1$ | $T_2$ |
| $T_1$ | $E_2$ | $T_2$ |
| $T_1$ | C | $T_2$ |

With = $T_1$: Pre-test, $T_2$: Post-test, $E_1$: OSCL, $E_2$: CRBL and C: Conventional Learning

This research aims to produce an Online Scientific Creativity Learning (OSCL) for improving the students' scientific creativity in the Covid-19 pandemic. Apart from looking for the validity of the OSCL, this research also emphasizes the analysis of the effectiveness of OSCL, CRBL, and conventional learning. The quality of the OSCL learning tool was assessed by 2 experts using a validation sheet. Scientific creativity of students is measured using the Scientific Creativity Test instrument (SCTI) detailed in Table 2 and then analyzed through the homogeneity test, normality test, Paired t-test, N-gain (Hake, 1998), and Independent t-test.

**Table 2:** Scientific Creativity Test Instrument (SCTI)

| **Scientific Creativity Test Instrument (SCTI)** | |
|---|---|
| Problem 1:<br>Unusual Uses | You are given three minutes.<br>List as many scientific uses of a capacitor as you can think of. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 2:<br>Problem Finding | You are given five minutes.<br>Imagine a Philips lamp with power P connected to an AC source state power plant (i.e. PLN) and an inductor. The maximum amount of electric current flowing in the circuit is<br>$I_{maks} = \frac{V_{maks}}{\sqrt{R_{Lampu}^2 + X_L^2}}$ , where $R_{Lamp} = \frac{P_{in\ lamp}}{V_{in\ lamp}^2}$. Write down as many problem formulas as you want for research. Don't stop writing until you are asked to stop. When |

| Scientific Creativity Test Instrument (SCTI) | |
|---|---|
| | asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 3: Product Improvement | You are given three minutes. List the possible repairs to an LCD (Liquid Crystal Display) projector so that It is easier to repair if it gets damaged. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 4: Scientific Imagination | You are given three minutes. Integrated Circuit (IC) is a combination of active and passive electronic components including hundreds or even millions of resistors and capacitors which are integrated into an electronic circuit in a small package. Imagine if IC has been used widely in everyday life, what would happen in this life! Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 5: Creatively Experiment Designing | You are given ten minutes. Two inductors that are identical but different in shape are provided. Write an experimental plan to test which inductor is better? Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 6: Science Creatively Problem Solving | You are given five minutes. Provided electronic components in the form of a reading lamp, inductor, capacitor, resistor, slide switch, and AC / DC source. Draw as many sequences as possible to make the reading light more versatile. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 7: Creatively Product Design | You are given ten minutes. Look at the test image of the RLC series below!   Describe a more secure and attractive experimental design of the RLC series circuit, then show the name and function of each part! Don't stop designing until you're asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |

(Ayas & Sak, 2014; Hu & Adey, 2010; Mukhopadhyay & Sen, 2013; Serway & Jewett, 2014; Siew et al., 2014; Suyidno et al., 2017; Walker et al., 2014)

To support the use of the SCTI, an assessment rubric was made. Rubric for assessing scientific creativity in this research is presented in Table 3.

**Table 3:** Rubric for assessing scientific creativity

| Indicators of Scientific Creativity | Dimensions of Creativity | Criteria |
|---|---|---|
| 1. Unusual uses 2. Problem finding 3. Product improvement 4. Scientific imagination 5. Science creatively problem solving | Fluency | Count all correct responses given. Each correct response is given a score of 1. |
| | Flexibility | Counts the number of correct approaches given. |
| | Originality | Tabulates the frequency of all the correct responses. The frequency and percentage of each response is calculated and the one with the smallest probability of response is chosen. If the response |
| 6. Creatively experiment designing | Originality | probability is less than 5%, the score is 2; if the probability of 5 to 10% is given a score of 1; if the response probability is greater than 10% it is given a score of 0. |
| | Flexibility | Counts the number of correct approaches given. |
| 7. Creatively product design | Originality | Give a score of 1 to 5 based on a holistic assessment. |
| | Flexibility | Each correct function is assigned a score of 1. |

## FINDINGS

### Validation Results

**Table 4:** The validity and reliability result of learning material and research instruments

| Components | Construct Validity | | Content Validity | |
|---|---|---|---|---|
| Online Lesson Plan of OSCL | Valid | Reliable | Valid | Reliable |
| Student Worksheet of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Student Learning Materials of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Online Learning Materials of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Scientific Creativity Test Instrument (SCTI) | Valid | Reliable | Valid | Reliable |

Table 4 shows that OSCL Quality, Learning Materials, and Research Instruments which is reviewed from the aspects of construct validity and content validity are categorized as valid and reliable. The validity and reliability result of learning material and research instruments must be fulfilled. This is a prerequisite for the development research carried out in this research. The validation process was carried out on 2 science education experts in higher education. these two experts assessed the quality of the tools and instruments developed by the researchers. The validation results are presented in Table 4. These results are used as the basis for continuing at the implementation stage.

**Scientific Creativity**

The results of student scientific creativity using OSCL, CRBL, and Conventional Learning were analyzed in the form of pre-test, posttest, and N-gain including each indicator of scientific creativity are presented in Table 5.

**Table 5.** The results of scientific creativity score

| Group | Scores | Scientific Creativity Indicator | | | | | | | Scientific Creativity |
|---|---|---|---|---|---|---|---|---|---|
| | | Unusua Uses | Problem Finding | Product Improvement | Scientific Imagination | Creatively Experiment Designing | Science Creatively Problem Solving | Creatively Product Design | |
| 1 (OSCL) | Pre-test | 1,91 | 0,03 | 1,76 | 1,71 | 0,14 | 1,80 | 1,42 | 1,25 |
| | Post-test | 2,75 | 3,01 | 2,77 | 2,91 | 2,56 | 2,86 | 2,43 | 2,76 |
| | N-gain | **0,40** | **0,75** | **0,45** | **0,52** | **0,63** | **0,48** | **0,39** | **0,55** |
| 2 (CRBL) | Pre-test | 1,15 | 0,59 | 1,20 | 1,26 | 0,56 | 1,59 | 2,01 | 1,19 |
| | Post-test | 2,72 | 2,06 | 2,96 | 2,59 | 2,72 | 2,94 | 3,16 | 2,74 |
| | N-gain | **0,55** | **0,43** | **0,63** | **0,49** | **0,63** | **0,56** | **0,58** | **0,55** |
| 3 (Conventional Learning) | Pre-test | 1,91 | 0,03 | 1,76 | 1,71 | 0,14 | 1,80 | 1,42 | 1,25 |
| | Post-test | 1,93 | 0,05 | 1,84 | 1,73 | 0,17 | 1,91 | 1,45 | 1,30 |
| | N-gain | **0,01** | **0,01** | **0,04** | **0,01** | **0,01** | **0,05** | **0,01** | **0,02** |

The results of students' scientific creativity using OSCL, CRBL, and Conventional Learning were carried out by parametric inferential statistical analysis (because the data met the requirements of homogeneity and were normally distributed) are presented in Table 6.

**Table 6:** Paired t-test of scientific creativity owned by students

| Group | N | Paired t-test | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std, error mean | T | df | p |
| 1 (OSCL) | 29 | -1,50 | 0,35 | -22,86 | 28 | 0,00 |
| 2 (CRBL) | 25 | -1,54 | 0,43 | -17,98 | 24 | 0,00 |
| 3 (Conventional Learning) | 29 | - 0,05 | 0,13 | -1,95 | 28 | 0,00 |

To find out more effective learning between OSCL, CRBL, and Conventional Learning in increasing (N-Gain) scientific creativity, it was tested using the Independent T-Test are presented in Table 7.

**Table 7:** Independent t-test of scientific creativity

| Group (N-gain) | N | Independent t-test | | | | |
|---|---|---|---|---|---|---|
| | | Mean Difference | Std. error mean | t | df | p |
| 1 (OSCL) & 2 (CRBL) | 54 | 0,01 | 0,03 | 0,19 | 52 | 0,84 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 (OSCL) & 3 (Conventional Learning) | 58 | 0,53 | 0,02 | 23,17 | 56 | 0,00 |
| 2 (CRBL) & 3 (Conventional Learning) | 54 | 0,52 | 0,02 | 22,70 | 52 | 0,00 |

**DISCUSSION**

The OSCL learning device has been proven valid and reliable (i.e. Table 4) consist of: Online Lesson Plan of OSCL; Student Worksheet of Scientific Creativity; Student Learning Materials of Scientific Creativity; Online Learning Materials of Scientific Creativity. In addition, The OSCL learning device has also been declared as novelty by the validators. OSCL learning devices meet the latest needs during the Covid-19 pandemic, which is to provide online-based learning tools that can be used in distance learning in the Universitas Negeri Surabaya. Another positive result is a learning device that is declared valid and reliable device can support OSCL implementation to increase students' scientific creativity. It is proven in Tables 5 and 6 that there is an improvement in scientific creativity of students. The results of this research are supported by the research findings of Dwikoranto et al. (2020), Pandiangan et al. (2017), Susantini et al. (2017), Susantini et al. (2016) stated that valid learning tools can improve learning outcomes.

Table 5 explains that in all groups (OSCL, CRBL, Conventional Learning) students' scientific creativity before learning is at a low level. The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. Implementation of OSCL to improve scientific creativity in phase 3: Guiding the investigation (OSCL); through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets (containing indicators of scientific creativity) includes: (1) Write down as many problem formulations as possible to investigate and isolate the problems to be selected for investigation; (2) Planning experiments; (3) Carry out the best possible experiment to get the correct data; (4) Analyze data and study various reference sources, especially teaching materials to find solutions to problems you want to solve accurately and deeply. In phase 3 (Guiding the investigation) through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets. This phase focus to train the indicators of scientific creativity such as Unusual Uses, Problem Finding, Product Improvement, Scientific Imagination, Creatively Experiment Designing, Science Creatively Problem Solving, Creatively Product Design. Phase 3 (OSCL) focuses on scientific investigation activities that are relevant to the research of Khan & Alotaibi, 2020; Mamun et al., 2020; Novo-corti, et al., 2013; Widodo et al., 2016; Yigit et al., 2014 found that investigations will activate students' scientific skills. In this third phase students are strengthened by scientific creativity through investigations using a virtual lab. This is perfect for online learning in the Covid-19 pandemic. Students and lecturers do not meet directly, but through the Zoom application. This can also reduce the transmission and spread of Covid-19, which until this article was written (19/10/2020) positive conditions in Indonesia are still increasing. Imagine if learning and experiments were forced using face to face, where students interacted directly and often students did not comply with the Covid-19 health protocol. The impact that will occur is a positive increase in the environment of the Universitas Negeri Surabaya and Universitas Lambung Mangkurat (research sites). The results of the latest research during the Covid-19 pandemic by Suryaman et al (2020) & Saputro et al (2020) stated that students responded positively to the experiment virtually during the Covid-19 pandemic.

The novelty of OSCL to increase scientific creativity through online learning in addition to phase 3 are also included in phase 4: Establishing scientific creativity (OSCL). Through the ZOOM application, the lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks as follows: (1) Through the ZOOM application, the lecturer guides students in the best possible presentation of the ZOOM and asks students to give suggestions to other students who are presenting, (2) Through the ZOOM application, lecturers help students discuss material and examples of problems in teaching materials, especially those that are not yet understood. In phase 4 (Establishing scientific creativity) focus to improve the students' scientific creativity through the ZOOM application. The lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks. This shows that after treatment in the OSCL and CRBL models it can improve scientific creativity (High level), while in Conventional Learning it is still at a low level. More specifically, OSCL (2.76 in high level) and CRBL (2.74 in high level). This shows that OSCL can be used to enhance scientific creativity. This finding is following the results of previous research (Suyidno et al., 2017; Zulkarnaen et al., 2017) that learning based on a valid scientific approach can increase students' scientific creativity. Besides, there is another support from the application of Vygotsky's scaffolding learning theory that students will be successful if they receive gradual guidance from lecturers through social learning.

Table 6 has shown that there is the same significance (N-gain at a moderate level) between OSCL and Creativity-Based Responsibility Based Learning (CRBL), except with conventional learning (N-gain at a low level). The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. It is a novelty that OSCL can accommodate CRBL weaknesses that require face-to-face meetings to enhance scientific creativity. By using OSCL, lecturers can increase students' scientific creativity through online learning. The findings of this study are supported by Wicaksono et al. (2017) Virtual-based scientific learning can for improving the students' scientific creativity. The effectiveness of OSCL as online learning is also covered by the dual coding theory that learning using multiple representations will provide more experience than to students compared to conventional learning (Siswanto et al., 2018; Siswanto et al., 2018).

**Commented [SR2]:** a and b?

## CONCLUSION

OSCL is an online science learning model that emphasizes responsibility and scientific skills in enhancing scientific creativity. OSCL has 5 (five) online-based syntax, namely: Generating scientific creative, Organizing creative learning needs, Guiding the investigation, Establishing scientific creativity, Evaluation and Reflection. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. OSCL can be an alternative for the scientific creativity of students in science education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a science learning innovation to improve student scientific creativity in the Covid-19 pandemic. In addition, OSCL can be an alternative digital learning solution in the science education. The limitation of this research, it was only conducted on science (i.e. physics) learning and the sample was only 83 students at Universitas Lambung Mangkurat and Universitas Negeri Surabaya, Indonesia. For further research: (1) OSCL can be applied to science education with other levels of education such as elementary school, junior high school and senior high school, (2) OSCL research based gender at the elementary school, junior high school and senior high school and higher education, and (3) applying OSCL to increase students' motivation in science education.

## ACKNOWLEDGMENT

Researchers would like to thank Civitas Academic of Universitas Lambung Mangkurat, and Universitas Negeri Surabaya, and Universitas PGRI Semarang for supporting this collaborative research during the Covid-19 pandemic. Especially to Assoc. Prof. Dr. Sri Astutik and Assoc. Prof. Dr. Dwikoranto for providing advice on quality science learning tools. In addition, researchers appreciate the editorial board and reviewers at Journal of Turkish Science Education who have provided suggestions for improving the quality of our articles.

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**Commented [SR3]:** Same writers and year. It should be 2018 a and 2018b

Widodo, A., Maria, R.A., & Fitriani, A. (2016). Peran praktikum rill dan praktikum virtual dalam membangun kreatifitas siswa. *Jurnal Pengajaran MIPA, 21*(1), 92-102. http://dx.doi.org/10.18269/jpmipa.v21i1.670.

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**Evaluation Form**

Manuscript Title: Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic

| | |
|---|---|
| **1.** | **Significance/relevance to special issue – the effects of covid-19 on science education**<br>This study focus on Online Scientific Creativity Learning (OSCL). Moreover, The Wademen Model was chosen in the research. It is thought that this study presents alternative solution in the era of the Covid-19 pandemic and produce an effective Online Scientific Creativity Learning (OSCL) to increase students' scientific creativity. |
| **2.** | **Conceptual framework (Connections to relevant constructs in literature)**<br>Literature review section should be expanded including why it is very important to increase students' scientific creativity in the process of Covid-19 pandemic. Furthermore, literature review explained the reasons why these activities were used (See Table 1). The reasons for choosing the activities in Table 1 and what will be done in the activities in the sub-dimensions of scientific creativity should be explained in detail. |
| **3.** | **Methods** |
| | **a) Appropriateness to questions**<br>Method is appropriate to research questions. |
| | **b) Adequate description of methods (including data collection and analysis)**<br>Plomp, 2013 presented as a reference and other reasons why wademen model was used in the study should be explained in detail. |
| | **c) Rigor of methods**<br>It is seen that there are no transitional sentences between tables, which do not provide explanations about Table 2 and 3. Likewise, the validity result of learning material and research instruments presented with table 4 but which studies were done for validity and reliability studies is not clarified. Process must be explained in detail only presenting with table seems inadequate. There need to be detailed informations about the rubrics. It is seen that, students' perfomance assesing with rubric which includes score of 1 to 5 based on a holistic assessment. On the other hand what are the expected performance definitions of students against each criterion in the rubric were not specified. Method can be reorganized using sample, data collection, data analysis and content-validity reliability studies headings. Information about abbreviations should be added under the table. |
| **4.** | **Findings/conclusions (are they literature or data-based)**<br>Table comments should be added below tables. The findings obtained under the tables are not summarized, and explanations about which sub-dimensions of creativity have been achieved or not have been added. Thus, discussion section should be enriched. Moreover, the results found in the study should be associated with the literature and should be explained in detail in the related studies. |

| | |
|---|---|
| **5.** | **Writing style/composition/clarity**<br>The legibility of the article is acceptable. |
| **6.** | **Final Decision – accepted (minor – major – no revisions) or rejected**<br>This study can contributed a significant effect to the literature in the era of the Covid-19 pandemic but there need to be a majör revision mentioned above. |

**Evaluation Form**

**Manuscript Title:** Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic

| | |
|---|---|
| **1.** | **Significance/relevance to special issue – the effects of covid-19 on science education**<br>Appropriate |
| **2.** | **Conceptual framework (Connections to relevant constructs in literature)**<br><br>The literature coverage is relevant and up-to-date. The rational and research objectives of the study have been clearly stated using related literature. |
| **3.** | **Methods** |
| | **a) Appropriateness to questions**<br><br>Appropriate |
| | **b) Adequate description of methods (including data collection and analysis)**<br><br>Appropriate |
| | **c) Rigor of methods**<br><br>Appropriate |
| **4.** | **Findings/conclusions (are they literature or data-based)**<br>Data analysis has been well documented.<br><br>The conclusion section could be developed a good deal with some possible reasons suggested for the findings and some suggested future research. |
| **5.** | **Writing style/composition/clarity**<br>Paper has been clearly written. |
| **6.** | **Final Decision – accepted (minor – major – no revisions) or rejected**<br>It is appropriate to be published in TUSED after minor revision mentioned above. |

TÜRK FEN EĞİTİMİ DERGİSİ
Yıl 12, Sayı 3, Eylül 2015

Journal of
TURKISH SCIENCE EDUCATION
Volume 18, Issue 2, June 2021

http://www.tused.org

# Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic

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**Received:** ….  **Revised:** …  **Accepted:** …

The original language of the article is in English (v.12, n.3, September 2015, pp.3-20, DOI: 10.12973/tused.10143a)

**Reference:** Prahani, B. K., Suprapto, N., Rachmadiarti, F., Sholahuddin, A., Mahtari, S., Suyidno, & Siswanto, J. (2021). Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic. *Journal of Turkish Science Education,* 18 (2), 1 – 13.

## ABSTRACT

The Wademen Model was chosen to develop the Online Scientific Creativity Learning (OSCL). The quality of OSCL is measured using an expert validation sheet. Students' scientific creativity is assessed using the Scientific Creativity Test Instrument (SCTI) and then analyzed through N-gain and parametric inferential statistical tests. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at a moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. The OSCL can be an alternative for the scientific creativity of students in science education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a learning innovation in science education to improve students' scientific creativity in the Covid-19 pandemic.

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**Keywords:** Covid-19 pandemic, higher education, learning innovation, OSCL, scientific creativity.

## INTRODUCTION

Scientific creativity cannot be separated from a part of human life. Scientific creativity is very important to train students as a provision for success in the world of work (Pangastuti & Fadhillah, 2020; Suyidno et al., 2019; Zulkarnaen et al., 2017). Scientific creativity is skills to produce new ideas or new products that are relevant to the context and have scientific uses (Hu et al., 2010; Hu et al., 2013; Kang et al., 2015; Ozdemir & Dikici, 2017; Park, 2012; Raj & Saxena, 2016; Zainuddin et al. 2020). Therefore, educators are obliged to train scientific creativity so that students can be successful. However, the results of preliminary found that the students' scientific creativity in physics at the Universitas Negeri Surabaya (i.e. Indonesia) was still low. Low scientific creativity is caused by conventional and monotonous learning which tends only to conceptualize and manage routine problems, as well as scientific activities through experiments (Zainuddin et al. 2020). The research results of Suyidno, Dewantara, Nur, & Yuanita (2017), which show the need to improve scientific investigation by optimizing scientific process skills in constructing knowledge and increasing the scientific creativity of students.

The low level of high-order thinking skills (i.e. scientific creativity) of students has something to do with the learning process used. Conventional learning, is less able to facilitate learning, resulting in low learning achievement including low scientific creativity (Hammond et al., 2015; Jatmiko et al., 2016). Therefore, to improve the quality of learning to facilitate the improvement of students' scientific creativity, among others is by implementing Creative Responsibility Based Learning (CRBL). Creativity Responsibility Based Learning (CRBL) is a creative learning model that optimum responsibility of the student in the success of scientific investigations and scientific creativity tasks (Suyidno et al., 2019; Suyidno et al., 2017). The results showed that CRBL was effective in increasing scientific creativity, science process skills, and responsibility (Suyidno et al., 2019; Suyidno et al., 2017). However, CRBL has been implemented through face-to-face learning.

The problem that arises in 2020 is that in Indonesia, learning has shifted to online learning (Abidah et al., 2020; Famularsih, 2020). The cause is the Covid-19 pandemic. The increasing development of Covid-19 virus cases in Indonesia has prompted working and doing activities from home or Work From Home (WFH). This policy from the government has been responded to positively by the Universitas Negeri Surabaya by issuing several policies related to lectures on campus, one of the important core contents is that face-to-face lectures are eliminated and replaced by online lectures and continue to study at home. This is not only positive but still creates new problems, namely that not all students and lecturers are ready for online learning. Besides, students' scientific creativity also needs to be improved, but students must stay at home because face-to-face lectures are eliminated and replaced by online. It is necessary to find a solution point for solving the problem so that there is no decrease in the quality of student graduates, including scientific creativity. Therefore, alternative solutions in this research aim to produce an effective Online Scientific Creativity Learning (OSCL) to increase students' scientific creativity. This alternative solution has never been done in previous research at the regional, national, and international levels. Another positive side is the existence of new innovative outputs that can be an alternative solution in the era of the Covid-19 pandemic.

## LITERATURE REVIEW

### Scientific Creativity

Students try to engage at every stage of creativity when they perceive some deficiency or mismatch, tension, or stimulation. The habit of avoiding the usual solutions by investigating, diagnosing, manipulating, making guesses and testing hunches, modifying and retesting until they find the desired solution (Al-khatib, 2012; Blascova, 2014; Cocu et al., 2015; Didin & Wiji, 2020; Gregory et al., 2013; Laisema & Wannapiroon, 2014; Saliceti, 2015; Yusnaeni et al., 2017; Zubaidah et al., 2017). Scientific creativity is emphasized on indicators of determining the usefulness of objects for scientific purposes, finding scientific problems, increasing the usefulness of a product technically, imagining scientifically, designing creative experiments, solving scientific problems creatively, and designing products creatively (Hu & Adey, 2010; Astutik et al., 2020; Chin & Siew, 2015; Florence et al., 2015; Rizqi et al., 2020; Usta & Akkanat, 2015; Zainuddin et al 2020). Very important to increase students' scientific creativity in the process of the Covid-19 pandemic. In terms of scientific creativity, researchers began working toward developing a vaccine against this novel coronavirus as soon as its genetic sequence became available in February 2020 (Kapoor & Kaufman, 2020; Ren et al., 2020). The improvement of scientific creativity in the science (i.e. physics) learning process can be done through: (a) scientific investigation, involving scientific process skills in scientific investigation activities; (b) understanding, involving students in understanding knowledge creatively; (c) presentations, involving students in building their knowledge through the delivery of ideas and sharing creative ideas with others; (d) application, facilitating students to find new ways of explaining scientific phenomena, making predictions, solving problems, and stating or implying what is not known; and (e) transformation, students are allowed to propose changes based on their knowledge and thoughts (Daud et al., 2012; Dhir, 2014; Kadayifci, 2017; OECD, 2014; Zainuddin et al 2020).

**Online Scientific Creativity Learning (OSCL)**

OSCL is an online learning model that emphasizes responsibility and scientific skills in enhancing scientific creativity. The development of the learning process in the OSCL is based on the scientific creativity hypothesis (Hu & Adey, 2010), and the latest learning theories: constructivism theory, complex cognitive processes, advanced organizer, and scaffolding (Arends, 2012; Eggen & Kauchak, 2013; Solso et al., 2008). OSCL was developed with the main aim of enhancing students' scientific creativity. OSCL has 5 (five) online-based syntaxes, namely: Generating scientific creativity, Organizing creative learning needs, Guiding the investigation, Establishing scientific creativity, Evaluation and Reflection.

**Table 1:** Activities of OSCL using ZOOM platform

| **Activities of OSCL** |
|---|
| **Phase 1: Generating scientific creativity (± 10 minutes)**<br>1. The lecturer opens the lesson by saying greetings then checks the attendance of students through the ZOOM application.<br>2. Flipped learning requires students to learn teaching materials at home independently before learning to use ZOOM.<br>3. Through the ZOOM application, the lecturer motivates by asking students to imagine or think outside the box to mention as many scientific uses as possible.<br>4. Through the ZOOM application, lecturers convey learning objectives, then remind that a sense of responsibility can generate imagination and courage to be more open to new, more creative ideas. |
| **Phase 2: Organizing creative learning needs (± 10 minutes)**<br>1. Through the ZOOM application, lecturers guide students in understanding science process skills, the need for tools and materials, as well as the PhET media for experiments referring to student activity sheets.<br>2. Through the ZOOM application, lecturers ask students to actively participate and ensure that they have teaching materials and student activity sheets, and logistics. |
| **Phase 3: Guiding the investigation (± 60 minutes)**<br>Through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets (containing indicators of scientific creativity) includes: |

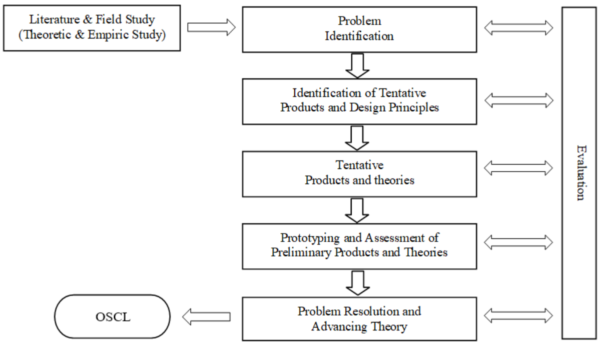
| Activities of OSCL |
| --- |
| 1. Write down as many problem formulations as possible to investigate and isolate the problems to be selected for investigation.<br>2. Planning experiments.<br>3. Carry out the best possible experiment to get the correct data.<br>4. Analyze data and study various reference sources, especially teaching materials to find solutions to problems you want to solve accurately and deeply. |
| **Phase 4: Establishing scientific creativity (± 60 minutes)**<br>Through the ZOOM application, the lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks as follows:<br>1. Through the ZOOM application, the lecturer guides students in the best possible presentation of the ZOOM and asks students to give suggestions to other students who are presenting.<br>2. Through the ZOOM application, lecturers help students discuss material and examples of problems in teaching materials, especially those that are not yet understood. |
| **Phase 5: Evaluation and Reflection (± 10 Minutes)**<br>1. Through the ZOOM application, the lecturer evaluates scientific creativity and reflecting on their responsibilities during the process of learning.<br>2. Through the ZOOM application, the lecturer asks students to work on an assessment sheet (if there is insufficient time, it can be continued independently).<br>3. Through the ZOOM application, the lecturer reminds students to re-learn materials for the next meeting. |

The reasons why these activities were used (See Table 1) are adapting activities from CRBL that have been proven valid, practical, and effective to increase scientific creativity (Suyidno et al, 2018). However, there are fundamental differences in OSCL, namely science learning carried out using ZOOM and during the Covid-19 pandemic, this has not been used in the implementation of CRBL. Table 1 describes the five phases of OSCL. OSCL was specifically developed to increase students' scientific creativity in science learning during the Covid-19 pandemic. In phase 1 (Generating scientific creative) has two points activities: (1) the lecturer motivates by asking students to imagine or think outside the box to mention as many scientific uses as possible; (2) Through the ZOOM application, lecturers convey learning objectives, then remind that a sense of responsibility can generate imagination and courage to be more open to new, more creative ideas. This phase focus to train the indicators of scientific creativity such as Unusual Uses and Scientific Imagination. In phase 2 (Organizing creative learning needs) focus to prepare the indicators of scientific creativity such as Creatively Experiment Designing, Science Creatively Problem Solving, and Creatively Product Design. In phase 3 (Guiding the investigation) through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets. This phase focus to train the indicators of scientific creativity such as Unusual Uses, Problem Finding, Product Improvement, Scientific Imagination, Creatively Experiment Designing, Science Creatively Problem Solving, Creatively Product Design. In phase 4 (Establishing scientific creativity) focus to improve the students' scientific creativity through the ZOOM application. The lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks. In phase 5 (Evaluation and Reflection) through the ZOOM application, the lecturer evaluates the scientific creativity and reflecting on their responsibilities during the process of learning.

**Commented [WK1]:** Please add your research questions and problem before the methodology.

## METHODS

This research is educational design research. The Wademen model was chosen to develop the OSCL (Plomp, 2007) with modifications including 1) problem systems, 2) tentative product and design principles, 3) tentative theory and products, 4) prototyping, and assessing products, and 5) improve product quality. Wademan's model was chosen because this model has advantages in terms of practicality and effectiveness to develop an innovative model that is novel and state of the art. Besides, researchers also developed OSCL-based learning tools presented in Figure 1.




(Adaptation: Wademan in Plomp, 2007)

**Figure 1:** Stages of Wademan model development (modification)

Populations were taken from 210 students at Universitas Negeri Surabaya dan Universitas Lambung Mangkurat, Indonesia based on the Slovin formula (Sevilla et al., 1984). Sample of this research was conducted in 3 groups, namely OSCL (29 Student of Universitas Negeri Surabaya), CRBL (25 Student of Universitas Lambung Mangkurat), and Conventional Learning (29 Student of Universitas Negeri Surabaya), where these three groups are homogeneous. True Experiment with Randomized Subject Control-group Pre-test and Post-test Design is used in this research (Fraenkel et al., 2012).

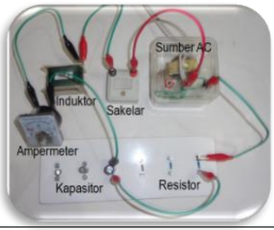
| | | |
|---|---|---|
| $T_1$ | $E_1$ | $T_2$ |
| $T_1$ | $E_2$ | $T_2$ |
| $T_1$ | C | $T_2$ |

With = $T_1$: Pre-test, $T_2$: Post-test, $E_1$: OSCL, $E_2$: CRBL, and C: Conventional Learning

This research aims to produce an Online Scientific Creativity Learning (OSCL) for improving the students' scientific creativity in the Covid-19 pandemic. Apart from looking for the validity of the OSCL, this research also emphasizes the analysis of the effectiveness of OSCL, CRBL, and conventional learning. The quality of the OSCL learning tool was assessed by 2 experts using a validation sheet. Scientific creativity of students is measured using the Scientific Creativity Test instrument (SCTI) detailed in Table 2 and then analyzed through the homogeneity test, normality test, Paired t-test, N-gain (Hake, 1998), and Independent t-test.

**Table 2:** Scientific Creativity Test Instrument (SCTI)

| Scientific Creativity Test Instrument (SCTI) | |
|---|---|
| Problem 1:<br>Unusual Uses | You are given three minutes.<br>List as many scientific uses of a capacitor as you can think of. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 2: | You are given five minutes. |

| Scientific Creativity Test Instrument (SCTI) | |
|---|---|
| Problem Finding | Imagine a Philips lamp with power P connected to an AC source state power plant (i.e. PLN) and an inductor. The maximum amount of electric current flowing in the circuit is $I_{maks} = \frac{V_{maks}}{\sqrt{R_{Lampu}^2 + X_L^2}}$ , where $R_{Lamp} = \frac{P_{in\ lamp}}{V_{in\ lamp}^2}$. Write down as many problem formulas as you want for research. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 3: Product Improvement | You are given three minutes. List the possible repairs to an LCD (Liquid Crystal Display) projector so that It is easier to repair if it gets damaged. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 4: Scientific Imagination | You are given three minutes. An integrated Circuit (IC) is a combination of active and passive electronic components including hundreds or even millions of resistors and capacitors which are integrated into an electronic circuit in a small package. Imagine if IC has been used widely in everyday life, what would happen in this life! Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 5: Creatively Experiment Designing | You are given ten minutes. Two inductors that are identical but different in shape are provided. Write an experimental plan to test which inductor is better? Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 6: Science Creatively Problem Solving | You are given five minutes. Provided electronic components in the form of a reading lamp, inductor, capacitor, resistor, slide switch, and AC / DC source. Draw as many sequences as possible to make the reading light more versatile. Don't stop writing until you are asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |
| Problem 7: Creatively Product Design | You are given ten minutes. Look at the test image of the RLC series below!   Describe a more secure and attractive experimental design of the RLC series circuit, then show the name and function of each part! Don't stop designing until you're asked to stop. When asked to stop, put down your writing instrument and turn your answer sheet! |

(Ayas & Sak, 2014; Hu & Adey, 2010; Mukhopadhyay & Sen, 2013; Serway & Jewett, 2014; Siew et al., 2014; Suyidno et al., 2017; Walker et al., 2014)

To support the use of the SCTI, an assessment rubric was made. Rubric for assessing scientific creativity in this research is presented in Table 3.

**Table 3:** Rubric for assessing scientific creativity

| Indicators of Scientific Creativity | Dimensions of Creativity | Criteria |
|---|---|---|
| 1. Unusual uses<br>2. Problem finding<br>3. Product improvement<br>4. Scientific imagination<br>5. Science creatively problem solving | Fluency | Count all correct responses given. Each correct response is given a score of 1. |
| | Flexibility | Counts the number of correct approaches given. |
| | Originality | Tabulates the frequency of all the correct responses. The frequency and percentage of each response ~~is~~ are calculated and the one with the smallest probability of response is chosen. If the response probability is less than 5%, the score is 2; if the probability of 5 to 10% is given a score of 1; if the response probability is greater than 10% it is given a score of 0. |
| 6. Creatively experiment designing | Originality | |
| | Flexibility | Counts the number of correct approaches given. |
| 7. Creatively product | Originality | Give a score of 1 to 5 based on a holistic assessment. |

| Indicators of Scientific Creativity | Dimensions of Creativity | Criteria |
|---|---|---|
| design | Flexibility | Each correct function is assigned a score of 1. |

## FINDINGS

### Validation Results

**Table 4:** The validity and reliability result of learning material and research instruments

| Components | Construct Validity | | Content Validity | |
|---|---|---|---|---|
| Online Lesson Plan of OSCL | Valid | Reliable | Valid | Reliable |
| Student Worksheet of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Student Learning Materials of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Online Learning Materials of Scientific Creativity | Valid | Reliable | Valid | Reliable |
| Scientific Creativity Test Instrument (SCTI) | Valid | Reliable | Valid | Reliable |

Table 4 shows that OSCL Quality, Learning Materials, and Research Instruments which are reviewed from the aspects of construct validity and content validity are categorized as valid and reliable. The validity and reliability results of learning material and research instruments must be fulfilled. This is a prerequisite for the development research carried out in this research. The validation process was carried out by 2 science education experts in higher education. these two experts assessed the quality of the tools and instruments developed by the researchers. The validation results are presented in Table 4. These results are used as the basis for continuing at the implementation stage.

### Scientific Creativity

The results of student scientific creativity using OSCL, CRBL, and Conventional Learning were analyzed in the form of pre-test, posttest, and N-gain including each indicator of scientific creativity are presented in Table 5.

**Table 5.** The results of the scientific creativity score

| Group | Scores | Scientific Creativity Indicator | | | | | | | Scientific Creativity |
|---|---|---|---|---|---|---|---|---|---|
| | | Unusua Uses | Problem Finding | Product Improvement | Scientific Imagination | Creatively Experiment Designing | Science Creatively Problem Solving | Creatively Product Design | |
| 1 (OSCL) | Pre-test | 1,91 | 0,03 | 1,76 | 1,71 | 0,14 | 1,80 | 1,42 | 1,25 |
| | Post-test | 2,75 | 3,01 | 2,77 | 2,91 | 2,56 | 2,86 | 2,43 | 2,76 |
| | N-gain | **0,40** | **0,75** | **0,45** | **0,52** | **0,63** | **0,48** | **0,39** | **0,55** |
| 2 (CRBL) | Pre-test | 1,15 | 0,59 | 1,20 | 1,26 | 0,56 | 1,59 | 2,01 | 1,19 |
| | Post-test | 2,72 | 2,06 | 2,96 | 2,59 | 2,72 | 2,94 | 3,16 | 2,74 |
| | N-gain | **0,55** | **0,43** | **0,63** | **0,49** | **0,63** | **0,56** | **0,58** | **0,55** |
| 3 (Conventional Learning) | Pre-test | 1,91 | 0,03 | 1,76 | 1,71 | 0,14 | 1,80 | 1,42 | 1,25 |
| | Post-test | 1,93 | 0,05 | 1,84 | 1,73 | 0,17 | 1,91 | 1,45 | 1,30 |
| | N-gain | **0,01** | **0,01** | **0,04** | **0,01** | **0,01** | **0,05** | **0,01** | **0,02** |

The results of students' scientific creativity using OSCL, CRBL, and Conventional Learning were carried out by parametric inferential statistical analysis (because the data met the requirements of homogeneity and were normally distributed) are presented in Table 6.

**Table 6:** Paired t-test of scientific creativity owned by students

| Group | N | Paired t-test | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std, error mean | T | df | p |
| 1 (OSCL) | 29 | -1,50 | 0,35 | -22,86 | 28 | 0,00 |
| 2 (CRBL) | 25 | -1,54 | 0,43 | -17,98 | 24 | 0,00 |
| 3 (Conventional Learning) | 29 | - 0,05 | 0,13 | -1,95 | 28 | 0,00 |

To find out more effective learning between OSCL, CRBL, and Conventional Learning in increasing (N-Gain) scientific creativity, it was tested using the Independent T-Test is presented in Table 7.

**Table 7:** Independent t-test of scientific creativity

| Group (N-gain) | N | Independent t-test | | | | |
|---|---|---|---|---|---|---|
| | | Mean Difference | Std. error mean | t | df | p |
| 1 (OSCL) & 2 (CRBL) | 54 | 0,01 | 0,03 | 0,19 | 52 | 0,84 |
| 1 (OSCL) & 3 (Conventional Learning) | 58 | 0,53 | 0,02 | 23,17 | 56 | 0,00 |
| 2 (CRBL) & 3 (Conventional Learning) | 54 | 0,52 | 0,02 | 22,70 | 52 | 0,00 |

## DISCUSSION

The OSCL learning device has been proven valid and reliable (i.e. Table 4) consists of Online Lesson Plan of OSCL; Student Worksheet of Scientific Creativity; Student Learning Materials of Scientific Creativity; Online Learning Materials of Scientific Creativity. In addition, The OSCL learning device has also been declared as a novel by the validators. OSCL learning devices meet the latest needs during the Covid-19 pandemic, which is to provide online-based learning tools that can be used in distance learning in the Universitas Negeri Surabaya. Another positive result is a learning device that is declared valid and reliable device can support OSCL implementation to increase students' scientific creativity. It is proven in Tables 5 and 6 that there is an improvement in the scientific creativity of students. The results of this research are supported by the research findings of Dwikoranto et al. (2020), Pandiangan et al. (2017), Susantini et al. (2017), Susantini et al. (2016) stated that valid learning tools can improve learning outcomes.

Table 5 explains that in all groups (OSCL, CRBL, Conventional Learning) students' scientific creativity before learning is at a low level. The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. Implementation of OSCL to improve scientific creativity in phase 3: Guiding the investigation (OSCL); through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets (containing indicators of scientific creativity) includes: (1) Write down as many problem formulations as possible to investigate and isolate the problems to be selected for investigation; (2) Planning experiments; (3) Carry out the best possible experiment to get the correct data; (4) Analyze data and study various reference sources, especially teaching materials to find solutions to problems you want to solve accurately and deeply. In phase 3 (Guiding the investigation) through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets. This phase focus to train the indicators of scientific creativity such as Unusual Uses, Problem Finding, Product Improvement, Scientific Imagination, Creatively Experiment Designing, Science Creatively Problem Solving, Creatively Product Design. Phase 3 (OSCL) focuses on scientific investigation activities that are relevant to the research of Khan & Alotaibi, 2020; Mamun et al., 2020; Novo-Corti, et al., 2013; Widodo et al., 2016; Yigit et al., 2014 found that investigations will activate students' scientific skills. In this third phase, students are strengthened by scientific creativity through investigations using a virtual lab. This is perfect for online learning in the Covid-19 pandemic. Students and lecturers do not meet directly but through the Zoom application. This can also reduce the transmission and spread of Covid-19, which until this article was written (19/10/2020) positive conditions in Indonesia are still increasing. Imagine if learning and experiments were forced using face-to-face, where students interacted directly and often students did not comply with the Covid-19 health protocol. The impact that will occur is a positive increase in the environment of the Universitas Negeri Surabaya and Universitas Lambung Mangkurat (research sites). The results of the latest research during the Covid-19 pandemic by Suryaman et al (2020) & Saputro et al (2020) stated that students responded positively to the experiment virtually during the Covid-19 pandemic.

The novelty of OSCL to increase scientific creativity through online learning in addition to phase 3 is also included in phase 4: Establishing scientific creativity (OSCL). Through the ZOOM application, the lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks as follows: (1) Through the ZOOM application, the lecturer guides students in the best possible presentation of the ZOOM and asks students to give suggestions to other students who are presenting, (2) Through the ZOOM application, lecturers help students discuss material and examples of problems in teaching materials, especially those that are not yet understood. In phase 4 (Establishing scientific creativity) focus to improve the students' scientific creativity through the ZOOM application. The lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks. This shows that after treatment in the OSCL and CRBL models it can improve scientific creativity (High level), while in Conventional Learning it is still at a low level. More specifically, OSCL (2.76 in high level) and CRBL (2.74 in high level). This shows that OSCL can be used to enhance scientific creativity. This finding is following the results of previous research (Suyidno et al., 2017; Zulkarnaen et al., 2017) that learning based on a valid scientific approach can increase students' scientific creativity. Besides, there is another support from the application of Vygotsky's scaffolding learning theory that students will be successful if they receive gradual guidance from lecturers through social learning.

Table 6 has shown that there is the same significance (N-gain at a moderate level) between OSCL and Creativity-Based Responsibility Based Learning (CRBL), except with conventional learning (N-gain at a low level). The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. It is a novelty that OSCL can accommodate CRBL weaknesses that require face-to-face meetings to enhance scientific creativity. By using OSCL, lecturers can increase students' scientific creativity through online learning. The findings of this study are supported by Wicaksono et al. (2017) Virtual-based scientific learning can for improving the students' scientific creativity. The effectiveness of OSCL as online learning is also covered by the dual coding theory that learning using multiple representations will provide more experience than to students compared to conventional learning (Siswanto et al., 2018; Siswanto et al., 2018).

## CONCLUSION

OSCL has 5 (five) online-based syntaxes, namely: Generating scientific creativity, Organizing creative learning needs, Guiding the investigation, Establishing scientific creativity, Evaluation and Reflection. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at a moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. OSCL can be an alternative for the scientific creativity of students in science education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a science learning innovation to improve student scientific creativity in the Covid-19 pandemic. In addition, OSCL can be an alternative digital learning solution in science education. The limitation of this research, it was only conducted on science (i.e. physics) learning, and the sample was only 83 students at Universitas Lambung Mangkurat and Universitas Negeri Surabaya, Indonesia. For further research: (1) OSCL can be applied to science education with other levels of education such as elementary school, junior high school, and senior high school, (2) OSCL research-based gender at the elementary school, junior high school, and senior high school and higher education, and (3) applying OSCL to increase students' motivation in science education.

## ACKNOWLEDGMENT

Researchers would like to thank Civitas Academic of Universitas Lambung Mangkurat, and Universitas Negeri Surabaya, and Universitas PGRI Semarang for supporting this collaborative research during the Covid-19 pandemic. Especially to Assoc. Prof. Dr. Sri Astutik and Assoc. Prof. Dr. Dwikoranto for providing advice on quality science learning tools. In addition, researchers appreciate the editorial board and reviewers at the Journal of Turkish Science Education who have provided suggestions for improving the quality of our articles.

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**Prof. Dr. Meral BEŞKEN ERGİŞİ**
Trabzon Üniversitesi, Fatih Eğitim Fakültesi

December, 04 2020
Dear Prof. Dr. Salih Çepni
Prof. Dr. Meral Beşken Ergişi

I am pleased to submit my paper entitled "Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic" for consideration as an Original Article for *Journal of Turkish Science Education.*

Online Scientific Creativity Learning (OSCL) is an online learning model in higher education that emphasizes responsibility and scientific skills in enhancing students' scientific creativity. OSCL has 5 (five) online-based syntax, namely: Generating scientific creative, Organizing creative learning needs, Guiding the investigation, Establishing scientific creativity, Evaluation and Reflection. The OSCL has been proven effective in increasing students' scientific creativity during the Covid-19 pandemic. There is no significant difference (N-gain at moderate level) between OSCL and Creativity Responsibility Based Learning (CRBL), except with Conventional Learning (N-gain at low level). The results of students' scientific creativity are at a high level after using OSCL and CRBL, while conventional learning is low. OSCL can be an alternative for the scientific creativity of students in science education. Besides, OSCL facilitates the responsibility and science process skills which are characteristic of being emphasized in the learning phases. The OSCL can be a science learning innovation to improve student scientific creativity in the Covid-19 pandemic. In addition, OSCL can be an alternative digital learning solution in the 4.0 industrial revolution. This research was only conducted on science (i.e. physics) learning and the sample was only 83 students at Universitas Lambung Mangkurat and Universitas Negeri Surabaya, Indonesia. For further research, it may be possible to research other level education and another subject.

I confirm that this manuscript has not been previously published and is not currently under consideration by any other journal. Additionally, I have approved the contents of this paper and have agreed to *Journal of Turkish Science Education*'s submission policies. To the best of my knowledge, I have no conflict of interest, financial or otherwise.

Best Regards,

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# REBUTTAL LETTER

March 25, 2021

Dear Editor-in-Chief of TUSED,
Prof. Dr. Salih ÇEPNİ
Professor, Science Education, Bursa Uludag University, Turkey

Thanks to editors and reviewers for having spent a great deal of time and care to provide positive recommendations for our manuscript. Researchers welcome all positive recommendations with pleasure because reviewer feedback has greatly helped improve the quality of our manuscript, title: *Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic*. Researchers have revised all feedback from the reviewer (attached). Researchers really hope that this manuscript can be published at Journal of Turkish Science Education (TUSED), 2021.

I confirm that this manuscript has not been previously published and is not currently under consideration by any other journal. Additionally, I have approved the contents of this paper and have agreed to *Journal of Turkish Science Education*'s submission policies. To the best of my knowledge, I have no conflict of interest, financial or otherwise. Thank you very much for all.

Best Regards,

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**Manuscript Title:** Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic

Evaluation Form (1)

| | Comments | Responds |
|---|---|---|
| 1 | **Significance/relevance to special issue – the effects of covid-19 on science education**<br>This study focus on Online Scientific Creativity Learning (OSCL). Moreover, The Wademen Model was chosen in the research. It is thought that this study presents alternative solution in the era of the Covid-19 pandemic and produce an effective Online Scientific Creativity Learning (OSCL) to increase students' scientific creativity. | Thank you very much |
| 2 | **Conceptual framework (Connections to relevant constructs in literature)**<br>Literature review section should be expanded including why it is very important to increase students' scientific creativity in the process of Covid-19 pandemic. Furthermore, literature review explained the reasons why these activities were used (See Table 1). The reasons for choosing the activities in Table 1 and what will be done in the activities in the sub-dimensions of scientific creativity should be explained in detail. | Thank you very much for your suggestions. We have revised the manuscript based on your suggestions.<br>1. Very important to increase students' scientific creativity in the process of Covid-19 pandemic. In terms of scientific creativity, researchers began working toward developing a vaccine against this novel coronavirus as soon as its genetic sequence became available in February 2020 (Kapoor & Kaufman, 2020; Ren et al., 2020).<br>2. The reasons why these activities were used (See Table 1) are adapting activities from CRBL that have been proven valid, practical and effective to increase scientific creativity (Suyidno et al, 2018). However, there are fundamental differences in OSCL, namely science learning carried out using ZOOM and during the Covid-19 pandemic, this has not been used in the implementation of CRBL. Table 1 describes the five phases of OSCL. OSCL was specifically developed to increase students' scientific creativity in science learning during the Covid-19 pandemic. In phase 1 (Generating scientific creative) has two points activities: (1) the lecturer motivates by asking students to imagine or think outside the box to mention as many scientific uses as possible; (2) Through the ZOOM |

| | Comments | Responds |
|---|---|---|
| | | application, lecturers convey learning objectives, then remind that a sense of responsibility can generate imagination and courage to be more open to new, more creative ideas. This phase focus to train the indicators of scientific creativity such as Unusual Uses and Scientific Imagination. In phase 2 (Organizing creative learning needs) focus to prepare the indicators of scientific creativity such as Creatively Experiment Designing, Science Creatively Problem Solving, and Creatively Product Design. In phase 3 (Guiding the investigation) through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets. This phase focus to train the indicators of scientific creativity such as Unusual Uses, Problem Finding, Product Improvement, Scientific Imagination, Creatively Experiment Designing, Science Creatively Problem Solving, Creatively Product Design. In phase 4 (Establishing scientific creativity) focus to improve the students' scientific creativity through the ZOOM application. The lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks. In phase 5 (Evaluation and Reflection) through the ZOOM application, the lecturer evaluates the scientific creativity and reflecting on their responsibilities during the process of learning. |
| 3 | Methods | |
| | a) Appropriateness to questions<br>Method is appropriate to research questions. | Thank you very much |
| | b) Adequate description of methods (including data collection and analysis)<br>Plomp, 2013 presented as a reference and other reasons why wademen model was used in the study should be explained in detail. | Thank you very much for your suggestions. We have revised the manuscript based on your suggestions.<br>This research is an educational design research. The Wademen model was chosen to develop the OSCL (Plomp, 2013) with modifications including 1) problem systems, 2) tentative product and design principles, 3) tentative theory and products, 4) prototyping, and assessing products, and 5) improve product quality. |

| | Comments | Responds |
|---|---|---|
| | | Wademan's model was chosen because this model has advantages in terms of practicality and effectiveness to develop an innovative model that is novelty and state of the art. |
| | c) Rigor of methods<br>It is seen that there are no transitional sentences between tables, which do not provide explanations about Table 2 and 3. Likewise, the validity result of learning material and research instruments presented with table 4 but which studies were done for validity and reliability studies is not clarified. Process must be explained in detail only presenting with table seems inadequate. There need to be detailed informations about the rubrics. It is seen that, students' perfomance assesing with rubric which includes score of 1 to 5 based on a holistic assessment. On the other hand what are the expected performance definitions of students against each criterion in the rubric were not specified. Method can be reorganized using sample, data collection, data analysis and content-validity reliability studies headings. Information about abbreviations should be added under the table. | Thank you very much for your suggestions. We have revised the manuscript based on your suggestions.<br><br>1. To support the use of the SCTI, an assessment rubric was made. Rubric for assessing scientific creativity in this research is presented in Table 3.<br>2. Table 4 shows that OSCL Quality, Learning Materials, and Research Instruments which is reviewed from the aspects of construct validity and content validity are categorized as valid and reliable. The validity and reliability result of learning material and research instruments must be fulfilled. This is a prerequisite for the development research carried out in this research. The validation process was carried out on 2 science education experts in higher education. these two experts assessed the quality of the tools and instruments developed by the researchers. The validation results are presented in Table 4. These results are used as the basis for continuing at the implementation stage. |
| 4 | Findings/conclusions (are they literature or data-based)<br>Table comments should be added below tables. The findings obtained under the tables are not summarized, and explanations about which sub-dimensions of creativity have been achieved or not have been | Thank you very much for your suggestions. We have revised the manuscript based on your suggestions.<br>1. In phase 3 (Guiding the investigation) through the ZOOM application, lecturers guide students to develop a sense of responsibility to solve problems referring to student activity sheets and key student activity sheets. This phase focus to train the indicators of scientific creativity such as Unusual Uses, Problem Finding, Product |

| | Comments | Responds |
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| | added. Thus, discussion section should be enriched. Moreover, the results found in the study should be associated with the literature and should be explained in detail in the related studies. | Improvement, Scientific Imagination, Creatively Experiment Designing, Science Creatively Problem Solving, Creatively Product Design. Phase 3 (OSCL) focuses on scientific investigation activities that are relevant to the research of Khan & Alotaibi, 2020; Mamun et al., 2020; Novo-corti, et al., 2013; Widodo et al., 2016; Yigit et al., 2014 found that investigations will activate students' scientific skills.<br>2. The results of the latest research during the Covid-19 pandemic by Suryaman et al (2020) & Saputro et al (2020) stated that students responded positively to the experiment virtually during the Covid-19 pandemic.<br>3. In phase 4 (Establishing scientific creativity) focus to improve the students' scientific creativity through the ZOOM application. The lecturer asks students to relearn indicators of scientific creativity along with examples of test items listed in teaching materials, then give responsibility in making two points of scientific creativity tests and their solutions with indicators according to the division of group tasks. This shows that after treatment in the OSCL and CRBL models it can improve scientific creativity (High level), while in Conventional Learning it is still at a low level. More specifically, OSCL (2.76 in high level) and CRBL (2.74 in high level). This shows that OSCL can be used to enhance scientific creativity. This finding is following the results of previous research (Suyidno et al., 2017; Zulkarnaen et al., 2017) that learning based on a valid scientific approach can increase students' scientific creativity. Besides, there is another support from the application of Vygotsky's scaffolding learning theory (Slavin, 2011) that students will be successful if they receive gradual guidance from lecturers through social learning. |
| 5 | **Writing style/composition/clarity**<br>The legibility of the article is acceptable. | **Thank you very much** |

| | Comments | Responds |
|---|---|---|
| 6 | Final Decision – accepted (minor – major – no revisions) or rejected<br>This study can contributed a significant effect to the literature in the era of the Covid-19 pandemic but there need to be a majör revision mentioned above. | Thank you very much for your suggestions. We have revised the manuscript based on your suggestions. |

Evaluation Form (2)

| | Comments | Responds |
|---|---|---|
| 7 | **Significance/relevance to special issue – the effects of covid-19 on science education**<br>Appropriate | Thank you very much |
| 8 | **Conceptual framework (Connections to relevant constructs in literature)**<br>The literature coverage is relevant and up-to-date. The rational and research objectives of the study have been clearly stated using related literature. | Thank you very much |
| 9 | **Methods** | |
| | **d) Appropriateness to questions**<br>Appropriate | Thank you very much |
| | **e) Adequate description of methods (including data collection and analysis)**<br>Appropriate | Thank you very much |
| | **f) Rigor of methods**<br>Appropriate | Thank you very much |
| 1 | **Findings/conclusions (are they literature or data-based)**<br>Data analysis has been well documented.<br>The conclusion section could be developed a good deal with some possible reasons suggested for the findings and some suggested future research. | Thank you very much for your advice.<br>We have revised by adding in manuscript:<br>*In addition, OSCL can be an alternative digital learning solution in the science education. The limitation of this research, it was only conducted on science (i.e. physics) learning and the sample was only 83 students at Universitas Lambung Mangkurat and Universitas Negeri Surabaya, Indonesia. For further research: (1) OSCL can be applied to science education with other levels of education such as elementary school, junior high school and senior high school, (2) OSCL research based gender at the elementary school, junior high school and senior high school and higher education, and (3) applying OSCL to increase students' motivation in science education.* |
| 1 | **Writing style/composition/clarity**<br>Paper has been clearly written. | Thank you very much |
| 1 | **Final Decision – accepted (minor – major – no revisions) or rejected**<br>It is appropriate to be published in TUSED after minor revision mentioned above. | Thank you very much |