iJET

International Journal:
Emerging Technologies in Learning

Platform &
workflow by

OJS / PKP

Editorial Team

Editor-in-Chief

- **Dominik May,** University of Georgia, United States

Executive Editor

- **Michael E. Auer,** CTI Frankfurt/Main - New York - Vienna - Bangalore

Associate Editors-in-Chief

- **Martin Ebner,** TU Graz, Austria
- **Mohammad Khalil,** University of Bergen, Norway

Associate Editors

- **Stamatios Papadakis,** School of Education, University of Crete, Greece
- **Neelakshi Chandrasena Premawardhena,** Department of Modern Languages, University of Kelaniya, Sri Lanka
- **Seshasai Srinivasan,** McMaster University, Canada
- **Valerie Varney,** Cologne University of Applied Science TH Köln, Germany
- **Xiaodong Zhang**, Beijing Foreign Studies University, China

Technical Editor

- **Sebastian Schreiter,** Lagorce, France

Editorial Board

- **A. Y. Al-Zoubi,** Princess Sumaya University for Technology, Jordan
- **Gerald Friedland,** International Computer Science Institute, Berkeley (CA), USA
- **Jesus Garcia,** Universidad de Alcala, Spain
- **Andreas Holzinger,** Medical University Graz, Austria

- **George S. Ioannidis,** University of Patras, Greece (Professor) "The Science Laboratory" - (Head of), Greece
- **Andreja Istenič,** University of Ljubljana, Slovenia University of Primorska, Slovenia University of North Texas, US
- **Barbara Kerr,** Ottawa University, Canada
- **Lars Knipping,** TU Berlin, Germany, Germany
- **Massimo Marchiori,** World Wide Web Consortium (W3C) at MIT, USA and University of Venice, Italy
- **Andreas Pester,** Carinthia University of Applied Sciences, Austria
- **Rob Reilly,** University of Memphis and MIT Media Lab, USA
- **Cornel Samoila,** Transilvania University Brasov, Romania
- **Gabriel Yue,** IETI, Hong Kong
- **Mario Žagar,** University of Zagreb, Croatia

INFORMATION

For Readers

For Authors

For Librarians

Platform &
workflow by
OJS / PKP

iJET International Journal of
Emerging Technologies in Learning

Vol. 14 No. 06 (2019)

PUBLISHED: 2019-03-29

PAPERS

Setting Up and Implementation of the Parallel Computing Cluster in Higher Education

Meruert Serik, Nursaule Karelkhan, Jaroslav Kultan, Zhandos Zulpykhar

pp. 4-17

PDF

Design and Implementation of Web-Based English Autonomous Learning System

Huimin Han

pp. 18-26

PDF

A Semantic Distances-Based Approach for a Deeply Indexing of Learning Objects

Kamal El Guemmat, Sara Ouahabi

pp. 27-40

PDF

Design of Students' Spoken English Pronunciation Training System Based on Computer VB Platform

Yanju Jin

pp. 41-52

PDF

SHORT PAPERS

The Effect of Presenting Anomalous Data on Improving Student's Critical Thinking Ability

Saiful Prayogi, Muhali Muhali, Sri Yuliyanti, Muhammad Asy'ari, Irham Azmi, Ni Nyoman Sri Putu Verawati

pp. 133-137

📄 **PDF**

Highly Efficient English MOOC Teaching Model Based on Frontline Education Analysis

Bo Gao

pp. 138-146

📄 **PDF**

The Development of Digital Book of European History to Shape the Students' Democratic Values

Ulfatun Nafiáh, Mashuri Mashuri, Daya Negri Wijaya

pp. 147-154

📄 **PDF**

INFORMATION

For Readers

For Authors

For Librarians

Vol. 14 No. 06 (2019) | International Journal of Emerging Technologies i...

https://online-journals.org/index.php/i-jet/issue/view/393

Platform &
workflow by
OJS / PKP

The Effect of Presenting Anomalous Data on Improving Student's Critical Thinking Ability

Saiful Prayogi (✉), Muhali, Sri Yuliyanti, Muhammad As'ary, Irham Azmi
Institut Keguruan dan Ilmu Pendidikan (IKIP), Mataram, Indonesia
saifulprayogi@ikipmataram.ac.id

Ni Nyoman Sri Putu Verawati
Universitas Mataram, Indonesia

Abstract—This study aims to explore the effects of presenting anomalous data on improving student's critical thinking ability. This study is an experimental research conducting on *one-group pretest-posttest design*. Purposive sampling was used in this study, where one class group was used as a sample of the study, namely 36 students of senior high school at MA Hidayaturrahmah NW Menggala, North Lombok, West Nusa Tenggara, Indonesia. The data of CT ability collected by instrument refer to Ennis-Weir Critical Thinking Essay Test. The data analysis descriptively and statistically were done to process the data of research. Path analysis was used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The results of this study indicate that the presenting anomalous data at initial learning have an effect and contribute on improving student's critical thinking ability. Further reviews are described in this article.

Keywords—Anomalous data, critical thinking ability

1 Introduction

The process of critical thinking is a cognitive activity to acquire knowledge and produce a new mental representation. It has cannot develop naturally, therefore it must be enriched by various stimuli and diverse environments. One stimulation that can be used in learning, namely the use of conflict cognitive strategies. Conflict cognitive is a condition where there is conflict in the cognitive structure of students [1]. Conflict occurs because of differences in the initial conceptions that students have with their learning experiences [2]. It occurs when students' mental balance is disrupted by experience (referred to as "anomalous data") that is not in accordance with their current understanding [3].

Critical thinking is one of the essential skills that learners have in the 21st century [4] and has become a major trend and center of learning, even curriculum authorities in some developed countries have included critical thinking skills in their curriculum as learning objectives [5]. For example, the University of California has proclaimed

"Executive Order 338" in 1983, that is, all learners learn to think critically according to the level of learning and become one of the basic competencies in learning. CT is reasonable and reflective thinking to deciding what to believe or do [6], its detailed description of some characteristic including the process of interpretation, analysis, evaluation, inference, explanation, and self-regulation [7]. Critical thinking is a high-level thinking area that can be taught continuously, and with the selection of appropriate learning strategies [8].

In practice, most teachers believe that developing critical thinking in learners are importance, however few of them have an idea of how to teach it [8]. Some previous researchers [9, 10, 11] recommended inquiry activities as a teaching foundation for the purpose to promoting 21st century skills need, including critical thinking. Through inquiry activities, learners are actively doing their knowledge so that the desired learning outcomes can be achieved [12].

Recently, the intervention of critical thinking processes has been conducted into the inquiry teaching, where the initial phase of learning is presented with conflict cognitive stimulated by the presentation of anomalous data for the purposed to improvement students' critical thinking ability [13]. To strengthen the results obtained, further research is needed to evaluate the effect of presenting anomalous data on improving student's critical thinking ability.

2 Methodology

This study is an experimental research with a design of one-group pretest-posttest design [14]. Purposive sampling was used in this study, where one class group was used as a sample of the study, namely 36 students of senior high school at MA Hidayaturrahmah NW Menggala, North Lombok, West Nusa Tenggara, Indonesia. The data of CT ability collected by instrument refer to Ennis-Weir Critical Thinking Essay Test. The data analysis descriptively and statistically were done to process the data of research. Statistical analysis was done in this study (homogeneity test, normality test, t test) to evaluate the effect of presenting anomalous data on improving student's critical thinking ability. Path analysis is used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The contribution is measurable from variable of learning feasibility and learning activities. Statistical data analysis in this study using Statistical Package for Social Science (SPSS) 23.0 software tools.

3 Results and Discussion

The results of the data output using the normality and homogeneity tests are p value (sig.) (0.200) > α (0.05) and p value (sig.) (0.282) > α (0.05) therefore it can be stated that the data are normally distributed and have the same variance (homogeneous). The result of testing the data of students' critical thinking ability using paired t-test shows that p value (sig.) (0.000) < α (0.05), it means that there is improvement of students' critical thinking ability between pretest score and posttest

score after treatment of presenting anomalous data during learning process. The measurement results of students' critical thinking ability showed that the average score of critical thinking on pretest was -1.42 with not-critical criterion (*not critical, if X ≤ 0.8*) and posttest of 8.06 with critical criterion (*critical, if 5.6 <X ≤ 8.8*), with n-gain of 0.72.

Table 1. The summary of the result of normality and homogeneity test

Variance	Homogenity		Normality	
	Levene's test score	*Sig.*	*N*	*Sig.*
Pretest-posttes	1,422	0.282	36	0.200

Table 2. The summary of the result of statistical test

Paired Samples Statistics					Paired Samples Test		
Pair	*Mean*	*Criteria*	*N*	*Std. Dev*	*Pair*	*Df*	*Sig.*
Pretest	-1,42	Not critical	36	1,58	Pretest-posttest	35	0.000
Posttest	8,06	Critical	36	2,37			

Path analysis is used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The contribution is measurable from variables of learning feasibility and learning activities. The average of learning feasibility (LF) and learning activities (LA) considered of 4.40 and 4.25, both of which are very good criterion (very good, if LF and LA ≥ 4.21), whereas improvement of critical thinking ability is measured from n-gain before and after learning by 0.72. The path analysis results are shown in Table 3.

Table 3. Results of path analysis contributing

	R	R Square	Adjusted R Square	Std. Err. Estimate
Presenting of anomalous data	0.833	0.758	0.272	6,37469

R Square value in Table 3 of 0.758 indicating that contribution of presenting of anomalous data to improvement of students' critical thinking ability of equal to 75.8%. While the rest of 24.2% is the contribution of other variables as effect of learning. The results of this study generally show that the presenting of anomalous data at the initial learning has a great impact on the improvement of students' critical thinking ability. Presenting anomalous data is very important to be done at the beginning of the learning to generate student motivation in learning. Teacher behavior at the beginning of learning affects the willingness, motivation, and formation of learners' beliefs about what they will learn [15, 16]. In addition, presenting anomalous data at initial learning is important to invite the learners' interest and ensure that initial knowledge emerges [17, 18, 19].

Presenting anomalous data on the other hand helps learners to reflect more about their ideas to provide an explanation of the phenomena studied [20]. Giving explanations based on the ideas or learned phenomena is one of the studies and a leading indicator of critical thinking [7, 21].

4 Conclusion

The results of this study indicate that the presenting anomalous data at initial learning have an effect and contribute on improving student's critical thinking ability.

5 References

[1] Kang, S., Scharmann, L.C., and Noh, T. (2004). Re-examining the role of cognitive conflict in science concept learning. Research in Science Education, 34, 71-96. https://doi.org/10.1023/B:RISE.0000021001.77568.b3

[2] Hewson, D. W., & Hewson, M. G. (1984). The Role of conceptual conflict in conceptual change and the design of science instruction. Instructional Science, 13, 1-13. https://doi.org/10.1007/BF00051837

[3] Foster, C. (2011). A slippery slope: Resolving cognitive conflict in mechanics. Teaching Mathematics and Its Applications, 30, 216-221. https://doi.org/10.1093/teamat/hrr015

[4] Partnership for 21st Century Skills. (2011). Frame Work for 21st Century Learning. www.p21.org.

[5] Bailin, S. (2002). Critical Thinking and Science Education. Science and Education. 11, 361-375. https://doi.org/10.1023/A:1016042608621

[6] Ennis, R. H. (1991). Critical Thinking: A Streamlined Conception. Teaching Philosophy. 14 (1): 5-24. https://doi.org/10.5840/teachphil19911412

[7] Facione, P. (2011). Critical Thinking. What It Is and Why Its Counts. Measured Reason and The California Academic Press

[8] Prayogi, S., Yuanita, L., & Wasis. Critical-Inquiry-Based-Learning: Model of Learning to Promote Critical Thinking Ability of Pre-service Teachers. IOP Conf. Series: Journal of Physics, 947: 1-7

[9] Fine, M. & Desmond, L. 2015. Inquiry-Based Learning: Preparing Young Learners for the Demands of the 21st Century. Educator's Voice VIII: 2-11.

[10] Hamlin, M., & Wisneski, D. (2012). Supporting the Scientific Thinking and Inquiry of Toddlers and Preschoolers through Play. Young Children 67 (3): 82-88.

[11] Wasis. (2016, Maret). Higher Order Thinking Skills (HOTS): Konsep dan Implementasinya. Seminar Nasional PKPSM IKIP Mataram, Mataram.

[12] Samarapungavan, A., Mantzicopoulos, P., & Patrick, H. (2008). Learning Science through Inquiry in Kindergarten. Science Education. 92 (5): 868-908 https://doi.org/10.1002/sce.20275

[13] Prayogi, S., Yuanita, L. & Wasis. (2018). Critical Inquiry Based Learning: A Model of Learning to Promote Critical Thinking Among Prospective Teachers of Physic. Journal of Turkish Science Education, 15(1), 43-56.

[14] Fraenkel, J.R., Wallen, N.E., & Hyun, H.H. (2012). How to Design and Evaluate Research in Education (8th ed.). New York: McGraw-Hill.

[15] Pintrich, P. R. (1999). Motivational Beliefs as Resources for and Constraints on Conceptual Change. In W. Schnotz, S. Vosniadou, dan M. Carretero (Eds.), New perspectives on conceptual change (pp. 33–50). Amsterdam: Pergamon.

[16] Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond Cold Conceptual Change: The Role of Motivational Beliefs and Classroom Contextual Factors in the Process of Conceptual Change. Review of Educational Research. 63 (2): 167-200. https://doi.org/10.3102/00346543063002167

[17] Ambrose, S., & Lovett, M. (2014). Prior Knowledge is More Than Content: Skills and Beliefs Also Impact Learning. Applying Science of Learning in Education 1 (2): 7-19.

[18] Chinn, C. A., & Malhotra, B. A. (2002). Children's Responses to Anomalous Scientific Data: How is Conceptual Change Impeded? Journal of Educational Psycholog 94: 327-343. https://doi.org/10.1037/0022-0663.94.2.327

[19] Chinn, C. A., & Brewer, W. F. (1998). An Empirical Text of A Taxonomy of Responses to Anomalous Data in Science. Journal of Research in Science Teaching. 35 (6): 623-654. https://doi.org/10.1002/(SICI)1098-2736(199808)35:6<623::AID-TEA3>3.0.CO;2-O

[20] Limon, M., & Carretero, M. (1997). Conceptual Change and Anomalous Data: A Case Study in the Domain of Natural Sciences. European Journal of Psychology of Education. 12 (2): 213-230 https://doi.org/10.1007/BF03173085

[21] Fisher, A. (2003). Critical Thinking An Introduction Anambridge University Press.

6 Authors

Saiful Prayogi is lecturer in Physics Education, faculty of Mathematics and Science Education, and member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Muhali is lecturer in Chemistry Education, faculty of Mathematics and Science Education, and member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Sri Yuliyanti is lecturer in Mathematic Education, faculty of Mathematics and Science Education

Muhammad Asy'ari is lecturer in Physics Education, faculty of Mathematics and Science Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia, and member of National Reviewer of Student Creativity Program, Ministry of Research, Technology and Higer Education, Republict of Indonesia.

Irham Azmi member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Ni Nyoman Sri Putu Verawati is a lecturer in Fundamental Physics course, majoring in Physics Education, Faculty of Teaching and Education, Universitas Mataram, Indonesia.

Source details

International Journal of Emerging Technologies in Learning

Open Access ⓘ

Scopus coverage years: from 2008 to Present

Publisher: International Association of Online Engineering

ISSN: 1868-8799   E-ISSN: 1863-0383

Subject area: (Social Sciences: Education) (Engineering: General Engineering)

Source type: Journal

[View all documents >]   [Set document alert]   💾 Save to source list

CiteScore 2020
2.6   ⓘ

SJR 2020
0.454   ⓘ

SNIP 2020
1.342   ⓘ

CiteScore   CiteScore rank & trend   Scopus content coverage

ⓘ   **Improved CiteScore methodology**   ✕

CiteScore 2020 counts the citations received in 2017-2020 to articles, reviews, conference papers, book chapters and data papers published in 2017-2020, and divides this by the number of publications published in 2017-2020.   Learn more >

CiteScore   2020 ⌄

$$2.6 = \frac{3{,}203 \text{ Citations 2017 - 2020}}{1{,}219 \text{ Documents 2017 - 2020}}$$

Calculated on 05 May, 2021

CiteScoreTracker 2021 ⓘ

$$3.8 = \frac{5{,}603 \text{ Citations to date}}{1{,}479 \text{ Documents to date}}$$

Last updated on 06 April, 2022 • Updated monthly

CiteScore rank 2020 ⓘ

Category	Rank	Percentile
Social Sciences └ Education	#333/1319	74th
Engineering └ General Engineering	#101/297	66th

View CiteScore methodology >   CiteScore FAQ >   Add CiteScore to your site 🔗

About Scopus

What is Scopus

Content coverage

Scopus blog

Scopus API

Privacy matters

Language

日本語に切り替える

切换到简体中文

切換到繁體中文

Русский язык

Customer Service

Help

Tutorials

Contact us

SJR   Scimago Journal & Country Rank

Enter Journal Title, ISSN or Publisher Name

Home   Journal Rankings   Country Rankings   Viz Tools   Help   About Us

International Journal of Emerging Technologies in Learning 🔓

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
Germany	Engineering	Kassel University Press	**24**
	Engineering (miscellaneous)		
Universities and research institutions in Germany	Social Sciences		
	Education		
	E-learning		

PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
Journals	18630383, 18688799	2008-2020	Homepage
			How to publish in this journal
			dominik.may@uga.edu

SCOPE

This interdisciplinary journal focuses on the exchange of relevant trends and research results and presents practical experiences gained while developing and testing elements of technology enhanced learning especially in the post secondary field. It bridges the gap between pure academic research journals and more practical publications. So it covers the full range from research, application development to experience reports and product descriptions. Our main field of publications is post secondary education. Fields of interest include, but are not limited to: -Online Learning Tools- Blended Learning- MOOCs, SPOCs- Knowledge Management in learning- Semantic Web Technologies- MashUp Technologies- Platforms and Content Authoring- New Learning Models and Applications- Pedagogical and Psychological Issues- Trust / Security- Internet Applications- Networked Tools- Visualisation- Language /Speech- Collaboration Tools / Collaborative Networks

🔍 Join the conversation about this journal

Quartiles

FIND SIMILAR JOURNALS ❓   options ⋮

All quartiles	All countries	All subject categories

1	2	3	4	5
International Journal of Interactive Mobile	Education and Information Technologies	International Journal of Learning Technology	International Journal of Technology Enhanced	International Journal of Educational Technology in
DEU	USA	CHE	CHE	NLD
51%	**50%**	**50%**	**49%**	**48%**
similarity	similarity	similarity	similarity	similarity

SJR	Total Documents	Citations per document

Total Cites Self-Cites	External Cites per Doc Cites per Doc	

Cites / Doc. (4 years)
Cites / Doc. (3 years)
Cites / Doc. (2 years)

% International Collaboration	Citable documents Non-citable documents	Cited documents Uncited documents

International Journal of Emerging Technologies in...

Q2 Education
best quartile

SJR 2020
0.45
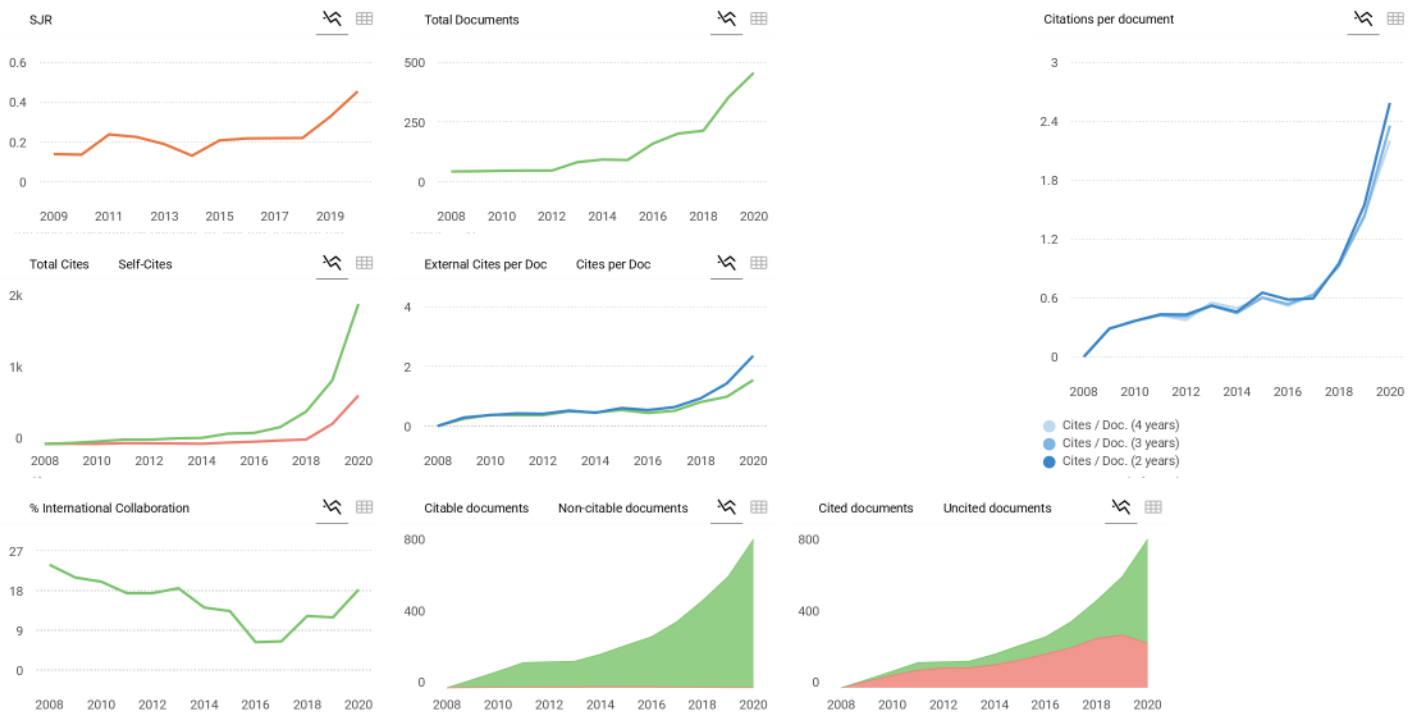
powered by scimagojr.com

← Show this widget in your own website

Just copy the code below and paste within your html code:

`<a href="https://www.scim`

G SCImago Graphica

Explore, visually communicate and make sense of data with our **new free tool**.

Get it

Metrics based on Scopus® data as of April 2021

Loi nguyen 4 months ago

Hi. Is the journal rank updated for 2021 and 2022? When is it reviewed?

reply

Melanie Ortiz 4 months ago SCImago Team

Dear Loi nguyen,
Thank you for contacting us. Our data come from Scopus, they annually send us an update of the data. This update is sent to us around April / May every year. The SJR for 2020 was released on 17 May 2021. Therefore, the indicators for 2021 will be available in May/June 2022.
Best Regards, SCImago Team

Arsalan 5 months ago

Hello,

I am trying to access the International Journal of Emerging Technologies in Learning (iJET) website on the url www.online-journals.org/index.php/i-jet/about/submissions . However, I am unable to access the website as I receive a pop-up window asking for username and password. I would like to know how to access the website. More importantly, I would like to know about the required format for submissions to iJET and any sample document that anyone might be able to provide. Thank you in advance.

reply

≡ **Gmail**   🔍 iJET

Compose

Mail

Inbox	772
Starred	
Snoozed	
Sent	
Drafts	9
More	

Chat

No conversations
Start a chat

Spaces

No spaces yet
Create or find a space

[iJET] Journal Registration External   Inbox ✕

Michael E. Auer auer@cti-online.net via lib-ojs5.lib.sfu.ca
to me

Saiful Prayogi

You have now been registered as a user with International Journal o
Emerging Technologies in Learning (iJET). We have included your u
password in this email, which are needed for all work with this journa
through its website. At any point, you can ask to be removed from th
journal's list of users by contacting me.

Username: yogi
Password: you are the only person who knows

Thank you,
Michael E. Auer

International Journal of Emerging Technologies in Learning (iJET)
http://www.i-jet.org

Reply   Forward

☰ **M** Gmail   🔍   iJET

Compose

Mail

Inbox	772
Starred	
Snoozed	
Sent	
Drafts	9
More	

Chat

💬

No conversations
Start a chat

Spaces

⊞

No spaces yet
Create or find a space

[iJET] Submission Acknowledgement   Ex

Michael E. Auer auer@cti-online.net <u>via</u> lib-ojs5.lib.sfu.ca
to me

Saiful Prayogi:

Thank you for submitting the manuscript, "The Effect of Presenting A
Data on Improving Student's Critical Thinking Ability" to International
Journal of Emerging Technologies in Learning (iJET). With the online
management system that we are using, you will be able to track its p
through the editorial process by logging in to the journal web site:

Manuscript URL:
http://online-journals.org/index.php/i-jet/author/submission/9717
Username: yogi

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

Michael E. Auer
International Journal of Emerging Technologies in Learning (iJET)
_____
International Journal of Emerging Technologies in Learning (iJET)
http://www.i-jet.org

Reply   Forward

The Effect of Presenting Anomalous Data on Improving Student's Critical Thinking Ability

Saiful Prayogi (✉), Muhali, Sri Yuliyanti, Muhammad As'ary and Irham Azmi
Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia
saifulprayogi@ikipmataram.ac.id

Ni Nyoman Sri Putu Verawati
Universitas Mataram, Indonesia

Abstract-This study aim to explore the effects of presenting anomalous data on improving student's critical thinking ability. This study is an experimental research conducting on *one-group pretest-posttest design*. Purposive sampling was used in this study, where one class group was used as a sample of the study, namely 36 students of senior high school at MA Hidayaturrahmah NW Menggala, North Lombok, West Nusa Tenggara, Indonesia. The data of CT ability collected by instrument refer to Ennis-Weir Critical Thinking Essay Test. The data analysis descriptively and statistically were done to process the data of research. Path analysis was used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The results of this study indicate that the presenting anomalous data at initial learning have an effect and contribute on improving student's critical thinking ability. Further reviews are described in this article.
Keyword: Anomalous data, critical thinking ability

1   Introduction

The process of critical thinking is a cognitive activity to acquire knowledge and produce a new mental representation. It's cannot develop naturally, therefore it must be enriched by various stimuli and diverse environments. One stimulation that can be used in learning, namely the use of conflict cognitive strategies. Conflict cognitive is a condition where there is conflict in the cognitive structure of students [1]. Conflict occurs because of differences in the initial conceptions that students have with their learning experiences [2]. It's occurs when students' mental balance is disrupted by experience (referred to as "anomalous data") that is not in accordance with their current understanding [3].

Critical thinking is one of the essential skills that learners have in the 21st century [4] and has become a major trend and center of learning, even curriculum authorities in some developed countries have included critical thinking skills in their curriculum as learning objectives [5]. For example, the University of California has proclaimed "Executive Order 338" in 1983, that is, all learners learn to think critically according to the level of learning and become one of the basic competencies in learning. CT is reasonable and reflective thinking to deciding what to believe or do [6], its detailed

description of some characteristic including the process of interpretation, analysis, evaluation, inference, explanation, and self-regulation [7]. Critical thinking is a high-level thinking area that can be taught continuously, and with the selection of appropriate learning strategies [8].

In practice, most teachers believe that developing critical thinking in learners are importance, however few of them have an idea of how to teach it [8]. Some previous researchers [9, 10, 11] recommended inquiry activities as a teaching foundation for the purpose to promoting 21st century skills needs, including critical thinking. Through inquiry activities, learners are actively doing their knowledge so that the desired learning outcomes can be achieved [12].

2   Methodology

This study is an experimental research with a design of one-group pretest-posttest design [14]. Purposive sampling was used in this study, where one class group was used as a sample of the study, namely 36 students of senior high school at MA Hidayaturrahmah NW Menggala, North Lombok, West Nusa Tenggara, Indonesia. The data of CT ability collected by instrument refer to Ennis-Weir Critical Thinking Essay Test. The data analysis descriptively and statistically were done to process the data of research. Statistical analysis was done in this study (homogeneity test, normality test, t test) to evaluate the effect of presenting anomalous data on improving student's critical thinking ability. Path analysis is used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The contribution is measurable from variable of learning feasibility and learning activities. Statistical data analysis in this study using Statistical Package for Social Science (SPSS) 23.0 software tools.

3   Results and Discussion

The results of the data output using the normality and homogeneity tests are p value (sig.) (0.200) > α (0.05) and p value (sig.) (0.282) > α (0.05) therefore it can be stated that the data are normally distributed and have the same variance (homogeneous). The result of testing the data of students' critical thinking ability using paired t-test shows that p value (sig.) (0.000) < α (0.05). The measurement result of students' critical thinking ability showed that the average score of critical thinking on pretest was -1.42 with not-critical criterion (*not critical, if $X \leq 0.8$*) and posttest of 8.06 with critical criterion (*critical, if $5.6 < X \leq 8.8$*), with n-gain of 0.72.

Table 1. The summary of the result of normality and homogeneity test

Variance	Homogenity		Normality	
	Levene's test score	Sig.	N	Sig.
Pretest-posttes	1,422	0.282	36	0.200

Table 2. The summary of the result of statistical test

Paired Samples Statistics					Paired Samples Test		
Pair	Mean	Criteria	N	Std. Dev	Pair	Df	Sig.

Commented [HOHs3]: you can state the essence of what you want to do in this study. The purpose of the study is also stated explicitly at the end of the introduction

Commented [HOHs4]: research methods have been stated briefly and clearly

Commented [HOHs5]: what is the meaning of the findings from this data?

Pretest	-1,42	Not critical	36	1,58	Pretest-posttest	35	0.000
Posttest	8,06	Critical	36	2,37			

Path analysis is used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The contribution is measurable from variables of learning feasibility and learning activities. The average of learning feasibility (LF) and learning activities (LA) considered of 4.40 and 4.25, both of which are very good criterion (very good, if LF and LA $\geq$ 4.21), whereas improvement of critical thinking ability is measured from n-gain before and after learning by 0.72. The path analysis results are shown in Table 3.

Table 3. Results of path analysis contributing

	R	R Square	Adjusted R Square	Std. Err. Estimate
Presenting of anomalous data	0.833	0.758	0.272	6,37469

R Square value in Table 3 of 0.758 indicating that contribution of presenting of anomalous data to improvement of students' critical thinking ability of equal to 75.8%. While the rest of 24.2% is the contribution of other variables as effect of learning. Presenting anomalous data is very important to be done at the beginning of the learning to generate student motivation in learning. Teacher behavior at the beginning of learning affects the willingness, motivation, and formation of learners' beliefs about what they will learn [15, 16]. In addition, presenting anomalous data at initial learning is important to invite the learners' interest and ensure that initial knowledge emerges [17, 18, 19].

Commented [HOHs6]: what is the meaning of the findings from this data?

Commented [HOHs7]: add the arguments that strengthen the research findings!

4   Conclusion

The results of this study indicate that the presenting anomalous data at initial learning have an effect and contribute on improving student's critical thinking ability.

5   References

[1] Kang, S., Scharmann, L.C., and Noh, T. (2004). Reexamining the role of cognitive conflict in science concept learning. Research in Science Education, 34, 71-96.

[2] Hewson, D. W., & Hewson, M. G. (1984). The Role of conceptual conflict in conceptual change and the design of science instruction. Instructional Science, 13, 1-13.

[3] Foster, C. (2011). A slippery slope: Resolving cognitive conflict in mechanics. Teaching Mathematics and Its Applications, 30, 216-221.

[4] Partnership for 21st Century Skills. (2011). *Frame Work for 21st Century Learning*. www.p21.org.

[5] Bailin, S. (2002). Critical Thinking and Science Education. *Science and Education.* 11, 361-375.

[6] Ennis, R. H. (1991). Critical Thinking: A Streamlined Conception. *Teaching Philosophy*. 14 (1): 5-24.

[7] Facione, P. (2011). *Critical Thinking. What It Is and Why Its Counts.* Measured Reason and The California Academic Press

[8] Prayogi, S., Yuanita, L., & Wasis. Critical-Inquiry-Based-Learning: Model of Learning to Promote Critical Thinking Ability of Pre-service Teachers. *IOP Conf. Series: Journal of Physics,* 947: 1-7

[9] Fine, M. & Desmond, L. 2015. Inquiry-Based Learning: Preparing Young Learners for the Demands of the 21st Century. *Educator's Voice* VIII: 2-11.

[10] Hamlin, M., & Wisneski, D. (2012). Supporting the Scientific Thinking and Inquiry of Toddlers and Preschoolers Through Play. *Young Children* 67 (3): 82-88.

[11] Wasis. (2016, Maret). *Higher Order Thinking Skills (HOTS): Konsep dan Implementasinya.* Seminar Nasional PKPSM IKIP Mataram, Mataram.

[12] Samarapungavan, A., Mantzicopoulos, P., & Patrick, H. (2008). Learning Science through Inquiry in Kindergarten. *Science Education.* 92 (5): 868-908

[13] Prayogi, S., Yuanita, L. & Wasis. (2018). Critical Inquiry Based Learning: A Model of Learning to Promote Critical Thinking Among Prospective Teachers of Physic. Journal of Turkish Science Education, 15(1), 43-56.

[14] Fraenkel, J.R., Wallen, N.E., & Hyun, H.H. (2012). How to Design and Evaluate Research in Education (8th ed.). New York: McGraw-Hill.

[15] Pintrich, P. R. (1999). *Motivational Beliefs as Resources for and Constraints on Conceptual Change*. In W. Schnotz, S. Vosniadou, dan M. Carretero (Eds.), New perspectives on conceptual change (pp. 33–50). Amsterdam: Pergamon.

[16] Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond Cold Conceptual Change: The Role of Motivational Beliefs and Classroom Contextual Factors in the Process of Conceptual Change. *Review of Educational Research.* 63 (2): 167-200.

[17] Ambrose, S., & Lovett, M. (2014). Prior Knowledge is More Than Content: Skills and Beliefs Also Impact Learning. *Applying Science of Learning in Education* 1 (2): 7-19.

[18] Chinn, C. A., & Malhotra, B. A. (2002). Children's Responses to Anomalous Scientific Data: How is Conceptual Change Impeded? *Journal of Educational Psycholog* 94: 327-343.

[19] Chinn, C. A., & Brewer, W. F. (1998). An Empirical Text of A Taxonomy of Responses to Anomalous Data in Science. *Journal of Research in Science Teaching*. 35 (6): 623-654.

[20] Limon, M., & Carretero, M. (1997). Conceptual Change and Anomalous Data: A Case Study in The Domain of Natural Sciences. *European Journal of Psychology of Education.* 12 (2): 213-230.

[21] Fisher, A. (2003). *Critical Thinking An Introduction*. Cambridge University Press.

6   Authors

Saiful Prayogi is lecturer in Physics Education, faculty of Mathematics and Science Education, and member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Muhali is lecturer in Chemistry Education, faculty of Mathematics and Science Education, and member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Sri Yuliyanti is lecturer in Mathematic Education, faculty of Mathematics and Science Education

Muhammad Asy'ari is lecturer in Physics Education, faculty of Mathematics and Science Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia, and member of National Reviewer of Student Creativity Program, Ministry of Research, Technology and Higer Education, Republict of Indonesia.

Irham Azmi member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Ni Nyoman Sri Putu Verawati is a lecturer in Fundamental Physics course, majoring in Physics Education, Faculty of Teaching and Education, Universitas Mataram, Indonesia.

The Effect of Presenting Anomalous Data on Improving Student's Critical Thinking Ability

Saiful Prayogi [✉], Muhali, Sri Yuliyanti, Muhammad As'ary and Irham Azmi
Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia
saifulprayogi@ikipmataram.ac.id

Ni Nyoman Sri Putu Verawati
Universitas Mataram, Indonesia

Abstract-This study aim to explore the effects of presenting anomalous data on improving student's critical thinking ability. This study is an experimental research conducting on *one-group pretest-posttest design*. Purposive sampling was used in this study, where one class group was used as a sample of the study, namely 36 students of senior high school at MA Hidayaturrahmah NW Menggala, North Lombok, West Nusa Tenggara, Indonesia. The data of CT ability collected by instrument refer to Ennis-Weir Critical Thinking Essay Test. The data analysis descriptively and statistically were done to process the data of research. Path analysis was used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The results of this study indicate that the presenting anomalous data at initial learning have an effect and contribute on improving student's critical thinking ability. Further reviews are described in this article.
Keyword: Anomalous data, critical thinking ability

1   Introduction

The process of critical thinking is a cognitive activity to acquire knowledge and produce a new mental representation. It's cannot develop naturally, therefore it must be enriched by various stimuli and diverse environments. One stimulation that can be used in learning, namely the use of conflict cognitive strategies. Conflict cognitive is a condition where there is conflict in the cognitive structure of students [1]. Conflict occurs because of differences in the initial conceptions that students have with their learning experiences [2]. It's occurs when students' mental balance is disrupted by experience (referred to as "anomalous data") that is not in accordance with their current understanding [3].

Critical thinking is one of the essential skills that learners have in the 21st century [4] and has become a major trend and center of learning, even curriculum authorities in some developed countries have included critical thinking skills in their curriculum as learning objectives [5]. For example, the University of California has proclaimed "Executive Order 338" in 1983, that is, all learners learn to think critically according to the level of learning and become one of the basic competencies in learning. CT is reasonable and reflective thinking to deciding what to believe or do [6], its detailed

description of some characteristic including the process of interpretation, analysis, evaluation, inference, explanation, and self-regulation [7]. Critical thinking is a high-level thinking area that can be taught continuously, and with the selection of appropriate learning strategies [8].

In practice, most teachers believe that developing critical thinking in learners are importance, however few of them have an idea of how to teach it [8]. Some previous researchers [9, 10, 11] recommended inquiry activities as a teaching foundation for the purpose to promoting 21st century skills needs, including critical thinking. Through inquiry activities, learners are actively doing their knowledge so that the desired learning outcomes can be achieved [12].

Recently, the intervention of critical thinking processes has been conducted into the inquiry teaching, where the initial phase of learning is presented with conflict cognitive stimulated by the presentation of anomalous data for the purposed to improvement students' critical thinking ability [13]. To strengthen the results obtained, further research is needed to evaluate the effect of presenting anomalous data on improving student's critical thinking ability.

2   Methodology

This study is an experimental research with a design of one-group pretest-posttest design [14]. Purposive sampling was used in this study, where one class group was used as a sample of the study, namely 36 students of senior high school at MA Hidayaturrahmah NW Menggala, North Lombok, West Nusa Tenggara, Indonesia. The data of CT ability collected by instrument refer to Ennis-Weir Critical Thinking Essay Test. The data analysis descriptively and statistically were done to process the data of research. Statistical analysis was done in this study (homogeneity test, normality test, t test) to evaluate the effect of presenting anomalous data on improving student's critical thinking ability. Path analysis is used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The contribution is measurable from variable of learning feasibility and learning activities. Statistical data analysis in this study using Statistical Package for Social Science (SPSS) 23.0 software tools.

3   Results and Discussion

The results of the data output using the normality and homogeneity tests are p value (sig.) (0.200) > α (0.05) and p value (sig.) (0.282) > α (0.05) therefore it can be stated that the data are normally distributed and have the same variance (homogeneous). The result of testing the data of students' critical thinking ability using paired t-test shows that p value (sig.) (0.000) < α (0.05), it means that there is improvement of students' critical thinking ability between pretest score and posttest score after treatment of presenting anomalous data during learning process. The measurement result of students' critical thinking ability showed that the average score of critical thinking on pretest was -1.42 with not-critical criterion (*not critical, if X ≤ 0.8*) and posttest of 8.06 with critical criterion (*critical, if 5.6 <X ≤ 8.8*), with n-gain of 0.72.

Table 1. The summary of the result of normality and homogeneity test

Variance	Homogenity		Normality	
	Levene's test score	Sig.	N	Sig.
Pretest-posttes	1,422	0.282	36	0.200

Table 2. The summary of the result of statistical test

Paired Samples Statistics					Paired Samples Test		
Pair	Mean	Criteria	N	Std. Dev	Pair	Df	Sig.
Pretest	-1,42	Not critical	36	1,58	Pretest-posttest	35	0.000
Posttest	8,06	Critical	36	2,37			

Path analysis is used to evaluate the contribution of presenting anomalous data on improving student's critical thinking ability. The contribution is measurable from variables of learning feasibility and learning activities. The average of learning feasibility (LF) and learning activities (LA) considered of 4.40 and 4.25, both of which are very good criterion (very good, if LF and LA ≥ 4.21), whereas improvement of critical thinking ability is measured from n-gain before and after learning by 0.72. The path analysis results are shown in Table 3.

Table 3. Results of path analysis contributing

	R	R Square	Adjusted R Square	Std. Err. Estimate
Presenting of anomalous data	0.833	0.758	0.272	6,37469

R Square value in Table 3 of 0.758 indicating that contribution of presenting of anomalous data to improvement of students' critical thinking ability of equal to 75.8%. While the rest of 24.2% is the contribution of other variables as effect of learning. The results of this study generally show that the presenting of anomalous data at the initial learning has a great impact on the improvement of students' critical thinking ability. Presenting anomalous data is very important to be done at the beginning of the learning to generate student motivation in learning. Teacher behavior at the beginning of learning affects the willingness, motivation, and formation of learners' beliefs about what they will learn [15, 16]. In addition, presenting anomalous data at initial learning is important to invite the learners' interest and ensure that initial knowledge emerges [17, 18, 19].

Presenting anomalous data on the other hand helps learners to reflect more about their ideas to provide an explanation of the phenomena studied [20]. Giving explanations based on the ideas or learned phenomena is one of the studies and a leading indicator of critical thinking [7, 21].

4   Conclusion

The results of this study indicate that the presenting anomalous data at initial learning have an effect and contribute on improving student's critical thinking ability.

5 References

[1] Kang, S., Scharmann, L.C., and Noh, T. (2004). Reexamining the role of cognitive conflict in science concept learning. Research in Science Education, 34, 71-96.

[2] Hewson, D. W., & Hewson, M. G. (1984). The Role of conceptual conflict in conceptual change and the design of science instruction. Instructional Science, 13, 1-13.

[3] Foster, C. (2011). A slippery slope: Resolving cognitive conflict in mechanics. Teaching Mathematics and Its Applications, 30, 216-221.

[4] Partnership for 21st Century Skills. (2011). *Frame Work for 21st Century Learning*. www.p21.org.

[5] Bailin, S. (2002). Critical Thinking and Science Education. *Science and Education*. 11, 361-375.

[6] Ennis, R. H. (1991). Critical Thinking: A Streamlined Conception. *Teaching Philosophy*. 14 (1): 5-24.

[7] Facione, P. (2011). *Critical Thinking. What It Is and Why Its Counts.* Measured Reason and The California Academic Press

[8] Prayogi, S., Yuanita, L., & Wasis. Critical-Inquiry-Based-Learning: Model of Learning to Promote Critical Thinking Ability of Pre-service Teachers. *IOP Conf. Series: Journal of Physics,* 947: 1-7

[9] Fine, M. & Desmond, L. 2015. Inquiry-Based Learning: Preparing Young Learners for the Demands of the 21st Century. *Educator's Voice* VIII: 2-11.

[10] Hamlin, M., & Wisneski, D. (2012). Supporting the Scientific Thinking and Inquiry of Toddlers and Preschoolers Through Play. *Young Children* 67 (3): 82-88.

[11] Wasis. (2016, Maret). *Higher Order Thinking Skills (HOTS): Konsep dan Implementasinya.* Seminar Nasional PKPSM IKIP Mataram, Mataram.

[12] Samarapungavan, A., Mantzicopoulos, P., & Patrick, H. (2008). Learning Science through Inquiry in Kindergarten. *Science Education.* 92 (5): 868-908

[13] Prayogi, S., Yuanita, L. & Wasis. (2018). Critical Inquiry Based Learning: A Model of Learning to Promote Critical Thinking Among Prospective Teachers of Physic. Journal of Turkish Science Education, 15(1), 43-56.

[14] Fraenkel, J.R., Wallen, N.E., & Hyun, H.H. (2012). How to Design and Evaluate Research in Education (8th ed.). New York: McGraw-Hill.

[15] Pintrich, P. R. (1999). *Motivational Beliefs as Resources for and Constraints on Conceptual Change*. In W. Schnotz, S. Vosniadou, dan M. Carretero (Eds.), New perspectives on conceptual change (pp. 33–50). Amsterdam: Pergamon.

[16] Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond Cold Conceptual Change: The Role of Motivational Beliefs and Classroom Contextual Factors in the Process of Conceptual Change. *Review of Educational Research.* 63 (2): 167-200.

[17] Ambrose, S., & Lovett, M. (2014). Prior Knowledge is More Than Content: Skills and Beliefs Also Impact Learning. *Applying Science of Learning in Education* 1 (2): 7-19.

[18] Chinn, C. A., & Malhotra, B. A. (2002). Children's Responses to Anomalous Scientific Data: How is Conceptual Change Impeded? *Journal of Educational Psycholog* 94: 327-343.

[19] Chinn, C. A., & Brewer, W. F. (1998). An Empirical Text of A Taxonomy of Responses to Anomalous Data in Science. *Journal of Research in Science Teaching*. 35 (6): 623-654.

[20] Limon, M., & Carretero, M. (1997). Conceptual Change and Anomalous Data: A Case Study in The Domain of Natural Sciences. *European Journal of Psychology of Education.* 12 (2): 213-230.

[21] Fisher, A. (2003). *Critical Thinking An Introduction*. Cambridge University Press.

6   Authors

Saiful Prayogi is lecturer in Physics Education, faculty of Mathematics and Science Education, and member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Muhali is lecturer in Chemistry Education, faculty of Mathematics and Science Education, and member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Sri Yuliyanti is lecturer in Mathematic Education, faculty of Mathematics and Science Education

Muhammad Asy'ari is lecturer in Physics Education, faculty of Mathematics and Science Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia, and member of National Reviewer of Student Creativity Program, Ministry of Research, Technology and Higer Education, Republict of Indonesia.

Irham Azmi member of Central Study of Science and Mathematics Education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Indonesia.

Ni Nyoman Sri Putu Verawati is a lecturer in Fundamental Physics course, majoring in Physics Education, Faculty of Teaching and Education, Universitas Mataram, Indonesia.

☰ **M Gmail**   🔍   iJET

Compose

Mail

Inbox   772
Starred
Snoozed
Sent
Drafts   9
More

Chat

💬

No conversations
Start a chat

Spaces

▯▯

No spaces yet
Create or find a space

[iJET] Editor Decision   External   Inbox ✕

Michael E. Auer auer@cti-online.net via lib-ojs5.lib.sfu.ca
to me

Saiful Prayogi:

We have reached a decision regarding your submission to Internatio
Journal of Emerging Technologies in Learning (iJET), "The Effect of
Presenting Anomalous Data on Improving Student's Critical Thinking
Ability".

Our decision is to: accept as is

Congratulation to your fine work.
You will receive an invoice for the APC with separate email.

Michael E. Auer
CTI Frankfurt - New York - Vienna
auer@cti-online.net

_____

International Journal of Emerging Technologies in Learning (iJET)
http://www.i-jet.org

Saiful Prayogi <saifulprayogi@ikipmataram.ac.id>
to Michael

Dear editor board of iJET

I want to confirm the schedule for the publication of our articles th

Best regard
Dr. Saiful Prayogi - Indonesia

Reply   Forward

≡ M Gmail

🔍 iJET

Compose

Mail

Inbox   772

Starred

Snoozed

Sent

Drafts   9

More

Chat

No conversations
Start a chat

Spaces

No spaces yet
Create or find a space

[iJET] Invoice publishing fee (Inv.: 2018-1

support@online-journals.org
to me

Dear Dr. Prayogi,

Please find attached to this e-mail the invoice for your iJET Article Process
needed).

Credit Card
If you choose to pay by credit card, please use the paypal link below to pa

https://www.paypal.com/cgi-bin/webscr?cmd=_s-xclick&hosted_button_id=

Bank Transfer
For payments via bank transfer please find the details in the attached invo

Thank you for working with us!
Sebastian Schreiter

online-journals.org

International Association
of Online Engineering   **IAOE.**
                                iJET
                        Publisher of

IAOE - Kirchengasse 10 1200 · A-1070 Wien · Austria

Prof. Dr.-Ing. Dr. sc. Michael E. Auer
Kirchengasse 10/200
A-1070 WIEN
Austria
Phone: +43 664 8959153
Fax: +49 12120 294752
info@online-engineering.org
www.online-engineering.org
05.11.2018

📄 **2018-191_Prayogi_.**

Saiful Prayogi <saifulprayogi@ikipmataram.ac.id>
to support

dear editor ijet
we have Paid the article payment charge. here we attach the proof.

sincerly yours
Dr. Saiful Prayogi

≡ **M** Gmail   🔍 iJET

Compose

Mail

Inbox   772

Starred

Snoozed

Sent

Drafts   9

More

Chat

No conversations
Start a chat

Spaces

No spaces yet
Create or find a space

[iJET] iJET Vol. 14, No. 06, 2019 – Your PD

support@online-journals.org
to me

Dear Dr. Prayogi,

the issue with your paper in it has been published. You may now dov

http://online-engineering.org/dl/iJET/iJET_vol14_no06_2019_S.pdf

Thank you for working with us!
Sebastian Schreiter

online-journals.org

Reply   Forward