

# Journal of Physics

## Conference Series

The 11th Biennial Conference on  
Classical and Quantum Relativistic  
Dynamics of Particles and Fields

1239

VOLUME 1239 – 2019

4–7 June 2018

Mexico, Toluca, Mexico

EDITOR

Marta Lora

The open access journal for conference proceedings

[iopscience.org/jpc](http://iopscience.org/jpc)

**IOP Publishing**



## 学術論文の文法チェッカー

学術論文の英文の質を瞬時に評価。

AJE

開く

Journal of Physics: Conference Series 

## COUNTRY

[United Kingdom](#)Universities and research  
institutions in United Kingdom

## SUBJECT AREA AND CATEGORY

[Physics and Astronomy](#)  
[Physics and Astronomy](#)  
(miscellaneous)

## PUBLISHER

[IOP Publishing Ltd.](#)

## H-INDEX

85

## PUBLICATION TYPE

Conferences and Proceedings

## ISSN

17426588, 17426596

## COVERAGE

2005-2020

## INFORMATION

[Homepage](#)[How to publish in this journal](#)[jpcs@ioppublishing.org](mailto:jpcs@ioppublishing.org)

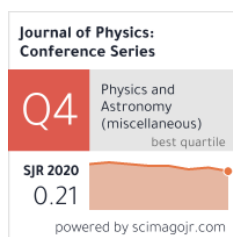
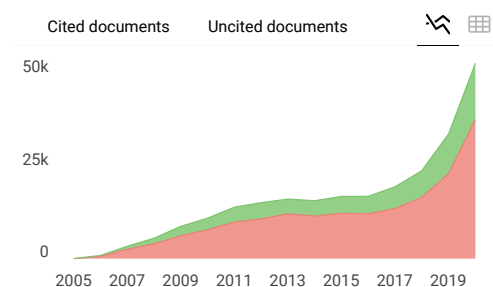
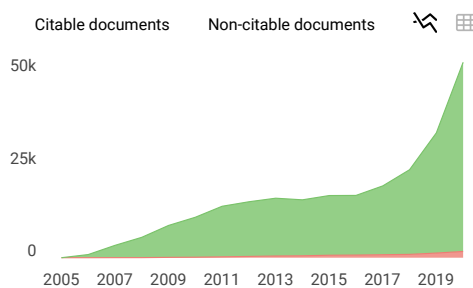
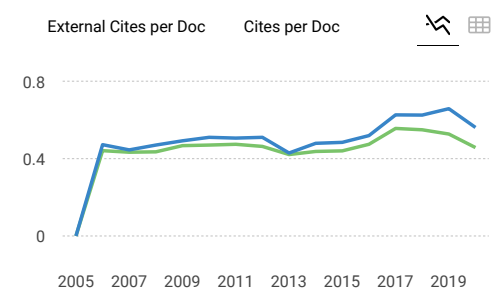
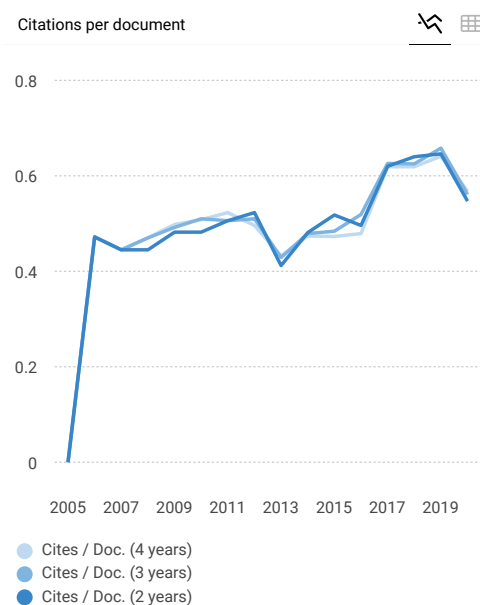
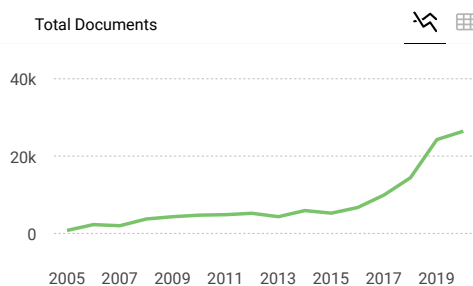
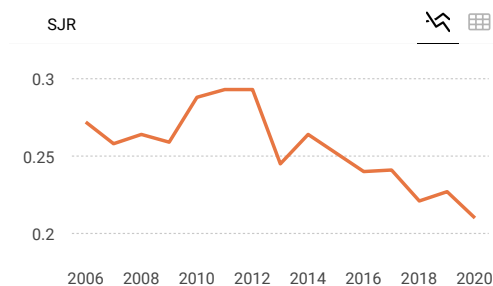
## SCOPE

The open access Journal of Physics: Conference Series (JPCS) provides a fast, versatile and cost-effective proceedings publication service.



Join the conversation about this journal

Quartiles



← Show this widget in your own website

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

```
<a href="https://www.scimagojr.com" data-bbox="568 703 694 713">
```



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

Get it





The open access *Journal of Physics: Conference Series (JPCS)* provides a fast, versatile and cost-effective proceedings publication service.

Latest published conferences

Vol 2144



Go

Conference archive

2021



Go

View forthcoming volumes accepted for publication.

If you would like more detailed information regarding *Journal of Physics: Conference Series* please visit [conferenceseries.iop.org](http://conferenceseries.iop.org), and if you are interested in publishing a proceedings with IOP Conference Series please visit our page for conference organizers.

**Conference organizers** can use our online form and we will get in touch with a quote and further details.

---

Most read

Most cited

**Latest articles**

## JOURNAL LINKS

---

Journal home

---

Journal Scope

---

Information for organizers

---

Information for authors

---

Contact us

---

Reprint services from Curran Associates

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).



## JOURNAL HISTORY

---

2004-present Journal of Physics: Conference Series

doi:10.1088/issn.1742-6596

Online ISSN: 1742-6596

Print ISSN: 1742-6588



PAPER • OPEN ACCESS

## Preface

To cite this article: 2021 *J. Phys.: Conf. Ser.* **1968** 011001

View the [article online](#) for updates and enhancements.

### You may also like

- [From one Congress to another](#)  
Geoffrey Webb
- [Welcome Message](#)
- [Risks from CT scans—what do recent studies tell us?](#)  
Linda Walsh, Roy Shore, Anssi Auvinen et al.



**IOP | ebooks™**

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection—download the first chapter of every title for free.

## PREFACE

In the past few years, rapid changes in many aspects of living happened globally. The issues of industrial revolution 4.0, global warming, and the Covid-19 pandemic must be challenged by the people of the world. Citizens in every country have to cope-up with those changes and strive into new normal routines. Higher education institutions hold the duty to anticipate that challenge.

The accomplishment of the 1st Webinar International Conference on Mathematics, Natural Sciences and Education in the New Normal Era, which was held Online on 15th October 2020 by FMIPA Universitas Negeri Manado-Indonesia, attended virtually by more than 300 participants of lecturers, researchers, teachers, graduate and undergraduate students from 12 universities across the country. Involved in 6 keynote speaker presentation; 4 foreign universities (Japan, Canada, Italy, Thailand) and 2 Indonesian.

This Webinar also consists of 7 tracks such as: Biology, Physics, Chemistry, Mathematics, Natural Science, Education and STEM (Science, Technology, Engineering and Mathematics).

As a continuance of this first Webinar, the Proceedings of 82 submitted abstracts are prepared. Hopefully, this Proceeding will be useful for all of us. After all, I would like to thank to all keynote speakers, presenters, participants, as well as to all parties who supported in the establishment of this Webinar.

Tondano, October 2020

The 1st International Conference Webinar on Mathematics, Natural Sciences and Education.  
Organizing Committee,

Dr. Victor R. Sulangi, MSc.Ed  
(Chairman)

### The Editors,

Nicky Tumulun

Yeremia Mokosuli

Ade Gafar Abdullah

Isma Widiaty

Cep Ubad Abdullah

Ari Arifin Danu Wijaya



## LIST OF COMMITTEE

### Advisory Board

Professor Giuseppe Di Fazio – Dipartimento di Matematica e Informatica, Università degli Studi di Catania Italia

Dr. M. V. Reddy – Institute of Research Hydro Quebec, Montreal Canada

Agustinus Robert Uria – Assistant Professor/Faculty Member at Hokkaido University, Japan

Dra. Vanny Maria Agustina Tiwow M.Sc. Ph.D. – Valaya Alongkorn Rajabhat University Under The Royal Patronage, Thailand

Hendry izaac Elim – Physics Department, Pattimura University, Indonesia

Prof. Maurits Sinyo Sumampou, M.Pd – Manado University, Indonesia

Prof. Dr. Astin Lukum, M.Si – Gorontalo University, Indonesia

Prof. Dr. H. Yaya Sukjaya Kusumah, M.Sc – Universitas Pendidikan Indonesia, Indonesia

Dr. Djeli Alvi Tulandi, M.Si – Manado University, Indonesia

### Scientific Committee

Dr. Victor R. Sulangi, MSc.Ed – Head of Mathematics Study Program Universitas Negeri Manado

Dr. Hany Sangian, M.Si – Head of Fisika Study Program Universitas Sam Ratulangi Manado

### Directing Committee:

Dr. Anetha L. F. Tilaar, M.Si. (Dean of FMIPA-UNIMA)

Dr. Wilson A. R. Rombang, M.Si. (Associate Dean)

Drs. F. Waworuntu, M.Pd. (Associate Dean)

Prof. Dr. M. Sumampouw, M.Pd. (Associate Dean)

### Organizing Committee:

Chair : Dr. Victor R. Sulangi, M.Sc.Ed

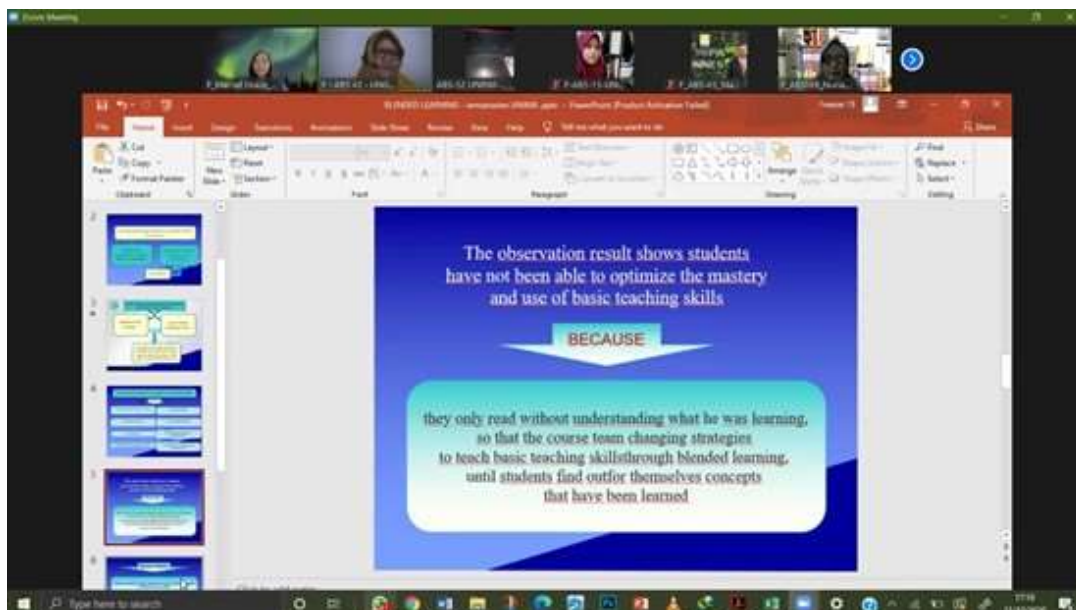
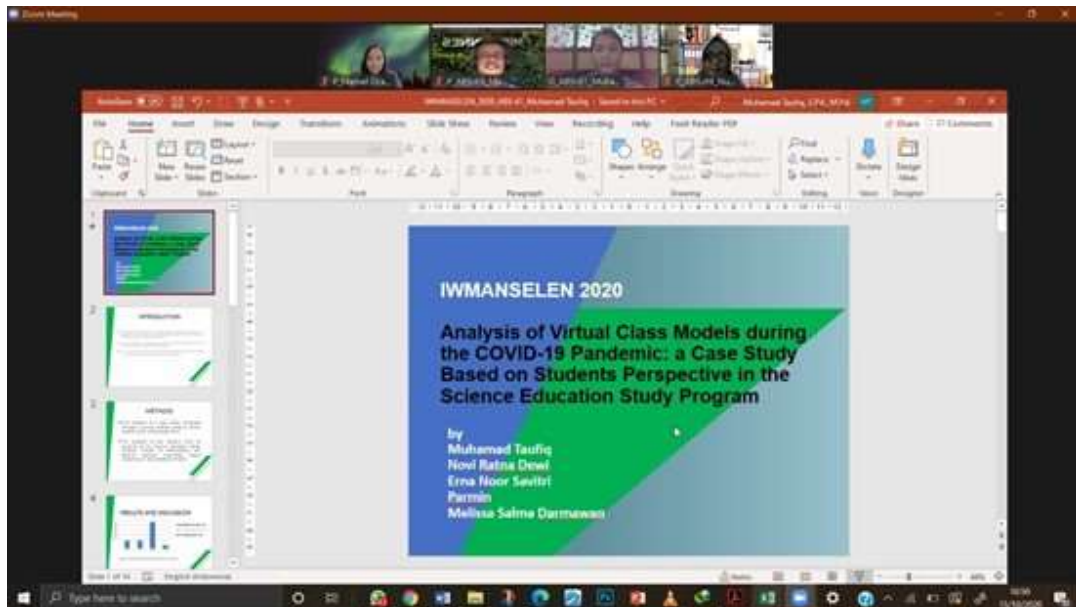
Vice-Chair : Dr. Jantje Ngangi, M.Si

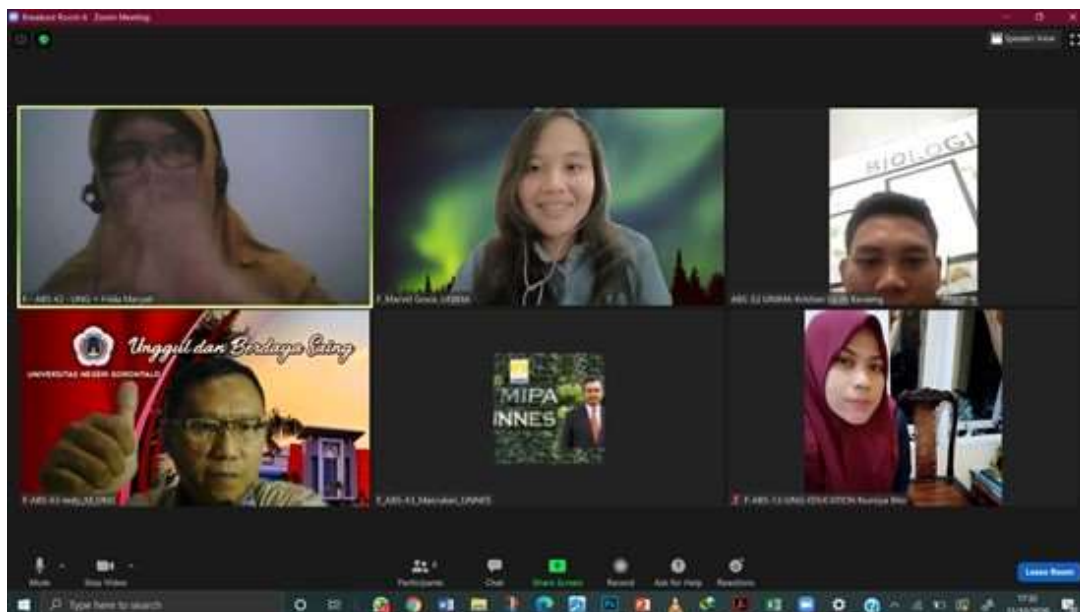
Secretary : Dr. Djeli Tulandi, M.Si

Vice Secretary : Dr. Djefry Tani, M.Si

Treasurer : Ms. Meis Naomi Mamuaya, S.Si, M.Si

## CONFERENCE PHOTOGRAPH





**KEYNOTE SPEAKER di WEBINAR FMIPA UNIMA 15 OKTOBER 2020****Professor Giuseppe Di Fazio ITALIA**



PAPER • OPEN ACCESS

## Peer review declaration

To cite this article: 2021 *J. Phys.: Conf. Ser.* **1968** 011002

View the [article online](#) for updates and enhancements.

You may also like

- [Peer review declaration](#)
- [Peer review declaration](#)
- [Peer review declaration](#)



**IOP | ebooks™**

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection—download the first chapter of every title for free.

## Peer review declaration

All papers published in this volume of Journal of Physics: Conference Series have been peer reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

- **Type of peer review:**  
Single-blind
- **Conference submission management system:**  
<http://mansera2020.starconf.org/>
- **Number of submissions received:** 82
- **Number of submissions sent for review:** 59
- **Number of submissions accepted:** 58
- **Acceptance Rate (Number of Submissions Accepted / Number of Submissions Received X 100) :** 70.7%
- **Average number of reviews per paper :** one review per paper
- **Total number of reviewers involved :** 4
- **Any additional info on review process :**  
Paper received by the committee was forwarded to the reviewer for a blind review. The result are return to the author to be revised according to reviewers suggestions. Then, the author sent the final paper to the committee by the website. From 82 submitted abstracts, there are 58 full paper to be reviewed and published.
- **Contact person for queries:**  
Name : Victor R. Sulangi  
Affiliation : Universitas Negeri Manado, Indonesia  
Email : editor.icmansera@gmail.com





Who do you want to contact

Conference Series ▼



**HEAD OF BOOKS AND CONFERENCE PROCEEDINGS PUBLISHING**

**David McDade**



**SENIOR PUBLISHER - CONFERENCE SERIES**

**Anete Ashton**





---

**COMMISSIONING EDITOR - CONFERENCE SERIES**  
Lorna Wroe



---

**COMMISSIONING EDITOR - CONFERENCE SERIES**  
Feichi Gao



---

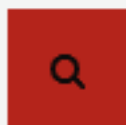
**CONFERENCE SERIES COORDINATOR**  
Kayleigh Parsons



---

**CONFERENCE SERIES COORDINATOR**  
Reyes Velazquez





## **PUBLICATIONS**

[Journals](#)

[Physics World](#)

[Conference Series](#)

[Books](#)

## **RESEARCHERS**

[Publishing Support](#)

[Author guidelines](#)

[Submit your paper](#)

[Checking the proofs of your journal article](#)

[Article structure](#)

[Editing services](#)

## **LIBRARIANS**

[Ordering](#)

[Continued Access Rights Policy](#)



[Jobs](#)

[Contacts](#)

## LEGAL

[Terms and conditions](#)

[Privacy and cookies](#)

[Copyright notice](#)

[Environmental policy](#)

[Disclaimer terms](#)

[Modern Slavery Policy](#)

[Gender Pay Gap Report](#)

[Advertising policy](#)

[Federated access privacy statement](#)

## SOCIAL



[BACK TO TOP](#)

# Table of contents

Volume 1968

2021

◀ Previous issue      Next issue ▶

**The 1st International Conference on Mathematics and Natural Sciences Education, Research and Assessment (ICMANSERA) 2020 15 October 2020, Manado, Indonesia**

Accepted papers received: 01 July 2021

Published online: 23 July 2021

Open all abstracts

## Preface

---

**OPEN ACCESS** 011001

Preface

+ Open abstract       View article       PDF

---

**OPEN ACCESS** 011002

Peer review declaration

+ Open abstract       View article       PDF

## Biology

---

**OPEN ACCESS** 012001

A review on arbuscular mycorrhizal fungal communities in response to disturbance

A V Amalia, N R Dewi, A P Heriyanti, F Daeni and R Atunnisa

+ Open abstract       View article       PDF

---

**OPEN ACCESS** 012002


The potency of curcumin and the thyroxine hormone to support the antioxidant activity during reproduction in common carp (*Cyprinus carpio* L)

L D Rawung, D J J Rayer and N Manampiring

+ Open abstract       View article       PDF

---

**OPEN ACCESS** 012003

Effectiveness of the application of the Group Investigation (GI) learning model  
This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.   
method of people tutors using e-learning via online and offline in increasing learning outcome of  
IPA for class VIIIA students at public middle school 2 Tutuyan East Bolaang Mongondow district

A Maatita, A Arrijani and A Yalindua

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012004

Physico-chemical exploration of Yam Flour (*Dioscorea alata* L.) as a raw material for processed cookies

A Yalindua, N Manampiring, F Waworuntu and F Y Yalindua

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012005

Project Based Learning (PjBL) integrated with realia media towards learning outcomes on students' creativity and learning interest in classification of living things at SMA Negeri 3 Tondano

S K Nukak, D J J Rayer and A A Maramis

[+ Open abstract](#) [View article](#) [PDF](#)

---

## Chemistry

---

**OPEN ACCESS**

012006

Biochemical characteristics and antibiotic resistance of bacterial isolate from *Ctenocephalides felis*

D Rombot and M Y Samuel

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012007

Development of audio-visual learning media integrating character education in chemistry learning to facilitate conceptual change and character strengthening of high school students

M Pikoli and A Lukum

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012008

Uric acid levels on sub-chronic oral administration of Cassava leaf extract

W H Nugrahaningsih, I B Wulandari, N A Habibah and A Marianti

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012009

Sun protecting factor value of the *Ficus benjamina* Linn. fruits extract

A A Aloanis, M Karundeng, V I Paat, S M T Tengker and O Siwu

[+ Open abstract](#) [View article](#) [PDF](#)

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.



## Synthesis and characterization of Schiff's base-based chemosensor and its detection potential of Fluoride ions

C Kurniawan, R R Wati, A T Prasetya, S Priatmoko, K Kasmui and H Bahron

[+ Open abstract](#) [View article](#) [PDF](#)

## The effect of the REACT CBA strategy on the material of reaction rate on student achievement at SMA Kristen 1 Tomohon

M Papia, W A R Rombang and M Karundeng

[+ Open abstract](#) [View article](#) [PDF](#)

## The influence of the learning approach of Science Technology Engineering and Mathematics (STEM) on attitudes and learning outcomes in class XI students of SMA Negeri 5 Halmahera Utara for material reaction rate

A S Manis, D Tani and W A R Rombang

[+ Open abstract](#) [View article](#) [PDF](#)

## Production and optimization of sea salt quality on the coast of Tomini Bay

A Lukum, E Mohamad, A D K Tangahu and S Y Ohi

[+ Open abstract](#) [View article](#) [PDF](#)

## Computer Science

## FTIR, SEM and XRD analysis of activated carbon from sago wastes using acid modification

W R Kunusa, H Iyabu and R Abdullah

[+ Open abstract](#) [View article](#) [PDF](#)

## Convolutional neural network for classification of skin cancer based on image data using google colab

I Kharisudin, A Hidayati, A Agoestanto and M Mashuri

[+ Open abstract](#) [View article](#) [PDF](#)

## Education

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.

Increased accuracy of prediction hepatitis disease using the application of principal

component analysis on a support vector machine

A Alamsyah and T Fadila

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012017

Nature-based learning management; How is it planned?

P M Silangen, F J A Oentoe, O Naharia and H Sumual

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012018

A development of multiple representation-based integrative science learning set to improve scientific literacy in the concept of heat

A H Odja

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012019

Mathematical problem solving ability based on self-efficacy in ICT-assisted preprospec learning model

N R Dewi, M Mulyono and A S Ardiansyah

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012020

Description and analysis of physics process on island hilly land for learning the availability of clean water for junior high school students

M Marianus and A Laira

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012021

Analysis of student's expectation on science virtual class models during the covid-19 pandemic era in science education study program

M Taufiq, N R Dewi, E N Savitri, P Parmin and M S Darmawan

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012022

Analysis of student error in solving story problems in linear program materials

F F Kaeng, J U L Mangobi and V E Regar

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012023

The development of Geogebra-assisted mathematics learning media on geometry of space flat-side of cubes and blocks

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.



A Pakaya and T Machmud

[+ Open abstract](#) [View article](#) [PDF](#)

---

OPEN ACCESS

012024

Biodiversity literacy in science education

A S Katili, R Utina, F M Yusuf, M Pikoli and L Dama

[+ Open abstract](#) [View article](#) [PDF](#)

---

OPEN ACCESS

012025

The influence of Edmodo application toward students understanding of slat hydolysis topic

F Linggama, A Lukum and M Paputungan

[+ Open abstract](#) [View article](#) [PDF](#)

---

## Mathematics

---

OPEN ACCESS

012026

Identification of students' conceptual understanding on electrolyte and non-electrolyte solution material using a three tier multiple choice test

S S Noho, M Sihaloho and W J A Musa

[+ Open abstract](#) [View article](#) [PDF](#)

---

OPEN ACCESS

012027

Numerical solution for system with Atangana-Baleanu-Caputo derivative: An influenza epidemic model

A S Purnomo, I Darti and A Suryanto

[+ Open abstract](#) [View article](#) [PDF](#)

---

OPEN ACCESS

012028

Distance weight of GWR-Kriging model for stunting cases in East Java

D Ardianti, H Pramoedyo and N Nurjannah

[+ Open abstract](#) [View article](#) [PDF](#)

---

OPEN ACCESS

012029

Modelling of silt content using geographically weighted regression

H Pramoedyo, S Riza, D Ardianti and A Oktaviarina

[+ Open abstract](#) [View article](#) [PDF](#)

---

OPEN ACCESS

012030

Development of e-learning device problem solving material and module sequence for more, learn PSM A State Kikap.



[+ Open abstract](#) [View article](#) [PDF](#)

## Physics

**OPEN ACCESS** 012031

Development of mathematics literacy problems based Bentenan's textile for Junior High School Students

D F Kaunang, V R Sulangi, S J A Sumarauw, C Pitoy and A N Agouw

[+ Open abstract](#) [View article](#) [PDF](#)

**OPEN ACCESS** 012032

Teaching and learning of electric charge with PIMCA model

F Nasra, SW Mongan, J Nusa, C Poluakan, AH Mondolang and J Lolowang

[+ Open abstract](#) [View article](#) [PDF](#)

**OPEN ACCESS** 012033

Analysis of student difficulties in learning refraction of light

F Dido, S Mongan, T Mandang, R Palilingan, A Mondolang and C Poluakan

[+ Open abstract](#) [View article](#) [PDF](#)

**OPEN ACCESS** 012034

Development of PIMCA learning model on magnetic field

R Patol, D A Tulandi, I Umboh, C Poluakan, A Komansilan and F Tumimomor

[+ Open abstract](#) [View article](#) [PDF](#)

**OPEN ACCESS** 012035

Analysis of daily dynamics of thermal interaction of temperature and ocean flow in seaweed growth areas

D A Tulandi and J V Tumangkeng

[+ Open abstract](#) [View article](#) [PDF](#)

**OPEN ACCESS** 012036

PIMCA learning models to improve student learning outcomes in optic magnifying glass tool

H Hartati, A H Mondolang, P M Silangen, D A Tulandi, M Marianus and C Poluakan

[+ Open abstract](#) [View article](#) [PDF](#)

**OPEN ACCESS** 012037

Teaching concept of materials with PIMCA model

R Koming, C Poluakan, P M Silangen, A H Mondolang and J Rende



[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012038

The application of multiple-choice in learning the doppler effect with PIMCA model

I E Tokolang, A H Mondolang, S W Mongan, C Poluakan, P Silangen and T Makahinda

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012039

Use of the four-tier diagnostic test with PIMCA model on learning of microscope

N S Lampeang, A H Mondolang, J V Tumangkeng, T Makahinda, I Umboh and C Poluakan

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012040

Implementation of the PIMCA model to learning convex mirror

S Reskin, P M Silangen, J V Tumangkeng, C Poluakan, T K Londa and A H Mondolang

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012041

Students learning difficulties in understanding the Lorentz force

R J Rettob, C Poluakan, D A Tulandi, S W Mongan and J Polii

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012042

Phyphox application with PIMCA learning model

L B Mayampoh, D A Tulandi, J Rende, C Poluakan and A Komansilan

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012043

The use of the MR-SR based PIMCA learning model in eye as optical tools subject

C Q Mamengko, C Poluakan, A H Mondolang, H Taunaumang and S W Mongan

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012044

Heat transfer analysis on the tool of heat exchanger of plate type

I Umboh and W A Rasu

[+ Open abstract](#) [View article](#) [PDF](#)

---

**Science, Technology, Engineering, and Mathematics (STEM)**

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more,

[open Access](#) and Cookies policy.

012045



---

**OPEN ACCESS**

012046

Seismicity of Suwawa Timur area based on analysis of earthquake: the depth and magnitude

N F Ponto, I N Manyoe, S A P Zakaria, M M Usman and S A I Sumarjis

---

**OPEN ACCESS**

012047

Assessment of the values of science, education, tourism and the risk degradation of Pentadio geothermal areas to developing geotourism in the Limboto Lake Plain, Gorontalo

I N Manyoe, Y I Arifin, S S S Napu and M D Suma

---

**OPEN ACCESS**

012048

Geological study of Pantai Indah for geotourism development based on geological observation and assessment of science, education, tourism and the risk degradation

Y I Arifin, I N Manyoe and S S S Napu

---

**OPEN ACCESS**

012049

Analysis of fluid characteristics and estimation of geothermal reservoir temperature in Kaleosan Area, North Minahasa Regency

J Polii, W Wantalangi, B Tambahani and R Ratumbusang

---

**OPEN ACCESS**

012050

Development of learning devices with the PBL model using the Pythagoras theorem of RME approach

V Rewah, V Sulangi and S Salajang

---

**OPEN ACCESS**

012051

Development of mathematic learning devices using Project Based Learning on a flat side room

H Mumu, V Sulangi and A Pangemanan

## Development of two variable linear equation system learning development with a problem-based learning model

R P Lainata, I W Damai and A Pesik

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

### OPEN ACCESS

012053

#### Analysis of ecotourism potentials of Botutonuo Beach in Bone Bolango Regency, Gorontalo Province

S Eraku, H Hendra, A P Permana, A Syamsurizal and N Baruadi

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

### OPEN ACCESS

012054

#### Surface and subsurface analysis based on the geological structure and electrical resistivity Data in Gorontalo Outer Ring Road (GORR), Huidu Utara

L C Robot, I N Manyoe, Y I Arifin, M J A Saputra, A A Bilgais, R A Abdullah and S S S Napu

[+ Open abstract](#)

[View article](#)

[PDF](#)

### JOURNAL LINKS

---

[Journal home](#)

---

[Journal Scope](#)

---

[Information for organizers](#)

---

[Information for authors](#)

---

[Contact us](#)

---

[Reprint services from Curran Associates](#)





---

PAPER • OPEN ACCESS

# A development of multiple representation-based integrative science learning set to improve scientific literacy in the concept of heat

A H Odja<sup>1</sup>

Published under licence by IOP Publishing Ltd

Journal of Physics: Conference Series, Volume 1968, The 1st International Conference on Mathematics and Natural Sciences Education, Research and Assessment (ICMANSERA) 2020 15 October 2020, Manado, Indonesia

**Citation** A H Odja 2021 *J. Phys.: Conf. Ser.* **1968** 012018


---

abdulharis@ung.ac.id

<sup>1</sup> Department of Physics Education, Universitas Negeri Gorontalo, Gorontalo, Indonesia

<https://doi.org/10.1088/1742-6596/1968/1/012018>

Buy this article in print

 Journal RSS

Sign up for new issue notifications

Create citation alert

## Abstract

This research has been conducted to, first, develop multiple representation-based integrative science learning set which encompassed lesson plan, student worksheet, teaching material (student book), scientific literacy test, and conceptual understanding; and second, find out impact of development of multiple representation-based integrative science learning set on scientific literacy skill and conceptual understanding of Natural Science. It was an Education Research and Development (R & D) that referred to 4-D method. After went through research stages, a product was created in the form of learning set and comprised Lesson Plan, Student Worksheet, Student Book, and Scientific Literacy Test and Conceptual Understanding of Heat (Natural Science). The learning set has been assessed by expert in his/her field and user in the field. Result of validation

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).

PDF

Help



revealed that the generated learning set was categorized as good while result of experiment for the learning set found an improvement in students' scientific literacy skill and conceptual understanding of Natural Science. The previous results were supported by value of gain for 0,42 and 0,53, which were included in medium category.

Export citation and abstract

[BibTeX](#)

[RIS](#)

◀ **Previous** article in issue

**Next** article in issue ▶



Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

---

## You may also like

### JOURNAL ARTICLES

---

Validity of Teaching Materials Based on Socio-Scientific Issues Approach on The Topic of Vibration, Waves, and Sound

---

Scientific and quantitative literacy: a comparative study between STEM and non-STEM undergraduates taking physics

---

Ability of the radial basis function approach to extrapolate nuclear mass

---

Automated identification of the predominant site of upper airway collapse in obstructive sleep apnoea patients using snore signal

---

Impact of non-normal error distributions on the benchmarking and ranking of quantum machine learning models

PDF

Help

---

Can the guided inquiry with environment learning resources increase conceptual understanding and scientific literacy?



PDF

Help

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.



PAPER • OPEN ACCESS

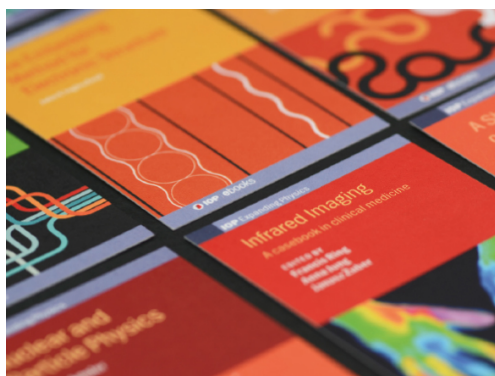
## A development of multiple representation-based integrative science learning set to improve scientific literacy in the concept of heat

To cite this article: A H Odja 2021 *J. Phys.: Conf. Ser.* **1968** 012018

View the [article online](#) for updates and enhancements.

### You may also like

- [Validity of Teaching Materials Based on Socio-Scientific Issues Approach on The Topic of Vibration, Waves, and Sound](#)  
K W Hariapsari, Tukiran and E Sudibyo
- [Scientific and quantitative literacy: a comparative study between STEM and non-STEM undergraduates taking physics](#)  
B Uzpen, A K Houseal, T F Slater et al.
- [Ability of the radial basis function approach to extrapolate nuclear mass](#)  
Tao Li, Haiwan Wei, Min Liu et al.



**IOP | ebooks™**

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection—download the first chapter of every title for free.

# A development of multiple representation-based integrative science learning set to improve scientific literacy in the concept of heat

A H Odja\*

Department of Physics Education, Universitas Negeri Gorontalo, Gorontalo, Indonesia

\*abdulharis@ung.ac.id

**Abstract.** This research has been conducted to, first, develop multiple representation-based integrative science learning set which encompassed lesson plan, student worksheet, teaching material (student book), scientific literacy test, and conceptual understanding; and second, find out impact of development of multiple representation-based integrative science learning set on scientific literacy skill and conceptual understanding of Natural Science. It was an Education Research and Development (R & D) that referred to 4-D method. After went through research stages, a product was created in the form of learning set and comprised Lesson Plan, Student Worksheet, Student Book, and Scientific Literacy Test and Conceptual Understanding of Heat (Natural Science). The learning set has been assessed by expert in his/her field and user in the field. Result of validation revealed that the generated learning set was categorized as good while result of experiment for the learning set found an improvement in students' scientific literacy skill and conceptual understanding of Natural Science. The previous results were supported by value of gain for 0,42 and 0,53, which were included in medium category.

## 1. Introduction

Result of learning evaluation based on high-order thinking skills, especially scientific literacy, reading and mathematics conducted by PISA (Programme for International Student Assessment) and TIMSS (Trends International Mathematics and Science Study) on Indonesian students is low compared to Asian and world countries. A report from the Organization for Economic Cooperation and Development (OECD) through PISA in 2009 related to the ability to read scientific literacy, mathematics puts Indonesia in 57th place out of 65 countries. Compared to other Asian countries, Indonesia was at the bottom of the list [1]. The same results were obtained in a study conducted by TIMSS 2011, which placed Indonesia in 40th place out of 45 participants with an average score of 406 [2].

The study conducted by PISA was also conducted by the Organization for Economic Cooperation and Development (OECD). The purpose of implementing educational evaluation is to improve the quality of education that focuses on scientific, reading, and mathematical literacies. This effort is believed to be influential for economic level of member countries. It is known that countries that perform a good performance in the PISA evaluation have on average developed economies and technology.

The low ability of students' scientific literacy is a basis for government to revise the 2006 to 2013 curriculum. Natural Science learning in SMP (Junior High School) level emphasizes two primary matters in the 2013 curriculum, which are first, Natural Science is developed as an integrative science subject, not as a scientific discipline education. Second, it is an applicative-oriented education,



developing thinking skills, learning abilities, curiosity, and developing a caring and responsible attitude towards the social and natural environment.

The application of Natural Science learning is currently done separately or partially, even though it is taught by the same teacher. Concept of physics is taught separately from concepts of biology and chemistry. The 2006 curriculum has made it possible due to each concept is separated by time, for example, in class VII, semester one is dominated by physics material while semester two is more about biology lesson. The application of integrative science learning allows students individually and in groups to interpret Natural Science holistically and authentically. Occasionally, students interpret a concept with the same meaning differently when learned conventionally (not integratively). For example, the concept of energy, if it is not studied integratively, its understanding and meaning will be different from the concepts of physics and biology.

The integration of several science sub-concepts that are interconnected with one another is expected to be able to create more meaningful concepts of science than a learning whose topic is taught separately (partially). The low scientific literacy skills of Indonesian students are often caused by partial Natural Science teaching while to respond the evaluation of scientific literacy by PISA requires a holistic conceptual link to concepts of science. The learning experience shows relation of learned conceptual will form a cognitive schema so that students get the wholeness and unanimity of the knowledge of Natural Science competencies holistically.

Integrated Science learning is one of the integrated learning. The learning strategy is based on an integrated curriculum approach that aims to create learning that is relevant and meaningful for students. According to Forgaty [3], there were ten curriculum models starting from a highly fragmented subject-oriented curriculum to an integrated learning model. The ten models were grouped into three classifications, namely: (1) Single disciplines which covered: Fragmented, Connected, and Nested Models; (2) Across several disciplines which covered: Sequenced, Shared, Webbed, Threaded, and Integrated Models; and (3) Within and across learners which covered: Immersed and Networked Models.

In addition to the integrated presentation of Natural Science topic, it must also pay attention to two realms of thought that are emphasized in core competencies, namely: concrete and abstract. One strategy for presenting topic that can cover both realms is multiple representation-based learning. Multiple representation is a way of teaching a concept in various ways and forms.

Representation supports students' understanding of physical principles or concepts by providing mental "pictures" for ideas. In addition, by producing and handling external representation, students construct cognitive of the situation or process being considered, thereby facilitating students' understanding on the basic principles [4].

This research has been conducted to, first, develop multiple representation-based integrative science learning set which encompassed lesson plan, student worksheet, heat concept teaching material (student book), scientific literacy test, and conceptual understanding of heat concepts; and second, find out impact of development of multiple representation-based integrative science learning set on scientific literacy skill and conceptual understanding of Natural Science.

## **2. Research methodology**

The research design used the Education Research and Development (R & D) method, which referred to the 4-D proposed by Thiagarajan, Semmel, and Semmel [5], which consisted of 4 stages, namely definition, design, development, and dissemination. However, this research was conducted only up to the development stage. The development stage is limited to limited testing by calculating the gain of students' scientific literacy skills on initial and final tests.

## **3. Research finding and discussion**

In the definition, initial-final analysis, student analysis, concept analysis, task analysis, indicator specification, and learning objectives were carried out. At the initial-final analysis stage through observation, the researcher found several trends in the Natural Science learning including: teachers

teaching Natural Science separately (partially) between physics, chemistry, and biology subjects; (2) the Natural Science learning was carried out through only one verbal representation (explanation) using blackboard media. This analysis was carried out to examine the characteristics of students that were in accordance with design and development, which included students' initial skills (student experience), both as individual and group through theoretical studies and previous research. Concept analysis and assignment were adjusted to the concepts in accordance with the proposed research material.

The design stage aimed to design a prototype of the multiple representation-based Integrative Science learning set. At this stage, a prototype of a learning set was produced in the form of an initial design of lesson plan, student book, teacher manual, student worksheet, and scientific literacy test and mastery of Natural Science concepts.

The purpose of the development stage was to produce a revised multiple representation-based Integrative Science learning set through expert validation, input from simulation result, and based on experimental data. The validation was carried out by 3 people, who were eligible to assess based on researcher's consideration to identify the quality of learning set that was compiled. Result of validation showed that the compiled learning set was in good category with minor revision in several parts.

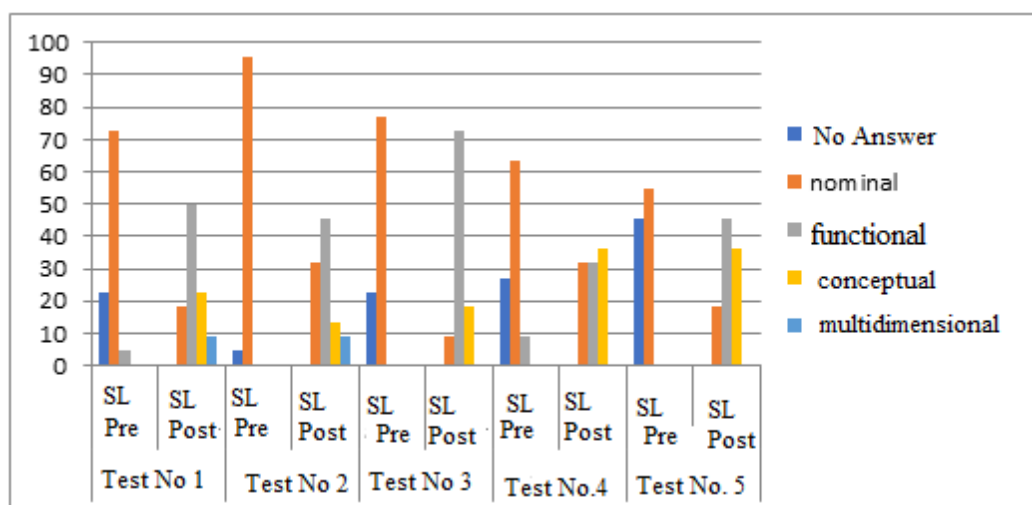
Meanwhile, result of simulation showed that there was a need for minor revision, especially in Lesson Plan 2 along with Student Worksheet 2 and Lesson Plan 3 along with Student Worksheet 3. The revision was associated with observation through laboratory activity for setting tools that made the duration of learning implementation not in accordance with the lesson plan. The final stage of research for the first year was limited testing of learning set. The testing was conducted in one of the State Junior High Schools in Bone Bolango District, Gorontalo Province. The initial test (pretest) was done before test of learning set, and it was to determine the initial skills of students. Meanwhile, the final test (posttest) was done after test of learning set. Also, the testing involved observation on the implementation of lesson plan and student activity.

Average score of the observed aspects for each category on the testing of multiple representation-based integrative science learning set included: Introduction was 3.8 with a very good category, main activity was 3.9 with a very good category, closing was 3.4 with a good category, and classroom atmosphere was 3,6 with a very good category. The result of data analysis also showed that the lesson plan for multiple representation-based integrative science learning was well implemented in limited testing.

Result of observation on student activity indicated that the dominant activity was the activity of observing, experimenting, and working in group and the minimum score of student activity was irrelevant behavior. The average score of student activity for observation was 19.39%, while the less relevant behavior was 4.62%.

Final analysis in the development stage was the analysis of scientific literacy skills and conceptual understanding. Result of the analysis showed that the results of scientific literacy and conceptual understanding of Natural Science increased from the free and posttests. The increase in the score of both scientific literacy and conceptual understanding was indicated by value of gain for 0.42 and 0.53, respectively. Based on the gain category by Hake [6], the values of 0.42 and 0.53 were included in the medium category.

Instead of doing quantitative analysis by calculating the normalized gain value of the scientific literacy score and conceptual understanding of the Natural Science, it was also carried out in a quantitative descriptive to categorize the answer to scientific literacy skills. The quantitative descriptive analysis was carried out by categorizing students' answers based on the scientific literacy answer categories adapted from Soobard & Rannikmäe [7], which consisted of nominal, functional, conceptual, and multidimensional. From the analysis, the following Figure 1 indicated students' answer categories



**Figure 1.** Categories of answers for scientific literacy test.

Figure 1 showed that students' answers on the pretest were included in three nominal, functional, and conceptual categories. Instead of these three categories, some students were unable to provide answers on scientific literacy tests. The percentage of students' answers in the nominal category ranged from 54%-95%, the functional category ranged from 4%-9%, while the other two categories were 0%. The percentage of students who did not answer the initial scientific literacy test ranged from 4% - 45%.

After conducting the multiple representation-based integrative science learning, the results of the students' answers performed better results. In detail, none of the students were unable to answer the scientific literacy test on the final test (0%). While students' answers were included in the nominal category which ranged from 9%-31%, functional category ranged from 31%-72%, conceptual category ranged from 13%-37%, and the multidimensional category ranged from 0%-10 %.

#### 4. Conclusion and recommendation

Based on the research finding and result of data analysis, several conclusions were drawn as follows:

- The multiple representation-based integrative science learning set comprised lesson plan, student worksheet, student book, and scientific literacy test as well as conceptual understanding test compiled based on the validation results showed good and very good categories of quality.
- The result of simulation also showed that the multiple representation-based integrative science learning could be implemented in Natural Science learning.
- The results of limited testing showed that after application of the multiple representation-based integrative science learning, the scientific literacy and conceptual understanding of Natural Science improved. This could be shown by the values of gain values of scientific literacy for 0.42 and 0.53, which were included in the medium category

#### References

- [1] PISA 2010 Assessment Framework Key Competencies In Reading ,mathematics and science. (OECD)
- [2] Michael 2012 TIMSS 2011 International Results in Science (Boston, USA: IEA TIMMS & PIRLS International Study Center)
- [3] Fogarty R 1991 How to Integrate the Curricula (Platine: Skylight Publishing-Inc.)
- [4] Ibrahim B and Rebello N S 2012 Representational task formats and problem solving strategies in kinematics and work *Physical Review Special Topics-Physics Education Research* **8**(010126)
- [5] Thiagarajan S, Semmel D S and Semmel M I 1974 Instructional Development for Training Teachers of Exceptional Children (Minnesota: Source Book. Bloominton: Center for Innovation on Teaching the Handicapped)

- [6] Cheng K K, Thacker B A, Cardenas R L and Crouch C 2004 Using Online Homework System Enhances Student Learning of Physics Concepts in an Introductory Physics Course *American Journal of Physics*
- [7] Soobard R and Rannikmäe M 2011 Assessing student's level of scientific literacy using interdisciplinary scenarios *Science Education International* 133-144