Proceedings of
2019 3rd International Conference on Education
and Multimedia Technology
(ICEMT 2019)

Nagoya, Japan
July 22-25, 2019

ISBN: 978-1-4503-7210-7
Table of Contents


Preface ........................................................................................................................................... x

Conference Committee .................................................................................................................. xi

◆ Session 1 ---- E-learning

♦ A Public Education and Promotion Analysis for Robot Model Design ......................................... 1  
  Ming-Yu Hsiao, Yann-Long Lee, Wen-Chih Chou, Cheng-Hui Tsai, En-Chu Yang

♦ Comparing Learning Effectiveness by Using Different Teaching Methods in the Course of Landscape Design .......................................................... 6  
  Sheng-Jung Ou, Wan-Jing Chang, Chu-Sheue Lin, Hsuan-Hung Chen, Yi-Xin Cai

♦ Online Collaborative Learning of a Mixed Team: A Case Study of Hotel and Tourism Students from Varied Education Backgrounds .............................................................................. 12  
  Joey Wu

♦ The Development of Project-Based Learning on Web to Enhance Creative Thinking for Design and Technology Subject of Grade 10 Students ........................................................................ 18  
  Pongsakorn Champabhoti, Phongthanat Sae-Joo

♦ The Using Results of Smart Online Learning for Sukhothai Thammathirat Open University’s Undergraduate Students ........................................................................................................... 23  
  Gan Chanyawudhiwan, Kemmanat Mingsiritham

♦ Fostering Students’ Question-generation Skill by Implementing an Online Inquiry-based Learning Platform: Stanford Mobile Inquiry-based Learning Environment (SMILE) ................................................... 27  
  Pyong Ho Kim

♦ Affective Learning Objectives in Online Courses ........................................................................ 33  
  Van Thanh Phan

♦ Student Learning Space: The Integration of Curriculum and Technology in Singapore .......... 37  
  Chan See Mun Alison, Umeda Kyoko, Nozaki Hironari

♦ A Study on the Intention of Using Online E-Learning Platform to Assist in Teaching of Junior High School Teachers ........................................................................................................ 41  
  Kuan-Chuan Tao, Tsui-Fang Hsieh, Chi-Yueh Hsu, Jen Jen Yang, Wei Yeng Sia

♦ Using E-learning in Classroom Management for Improving the Students' Motivation in Vocational Schools ........................................................................................................................................ 45  
  Faizatul Amalia, Adam Hendra Brata

♦ Life-Changing Digital Education on Environmental Protection and LOHAS ........................................ 50  
  Ting-sheng Weng

◆ Session 2 ---- Multimedia Teaching
The Relationship Between Listening Ability and the Ability to Write News Using Audiovisual Media for Middle School Students ................................................................. 55
  Mita Domi Fella Henanggil, Rona Syaputri Chania, Yeti Mulyati, Sumiyadi

Development Strategies for Multimedia Displays in Nantou County’s Local Cultural Museums .......... 60
  Kuo-Wei Hsu, Jen-Chih Chao

Video Lecture Styles in MOOCs by Malaysian Polytechnics ..................................................... 64
  Muhamad Izzat Rahim, Sarimah Shamsudin

The Use of Audio Media to Improve Students Motivation in English Subject at Junior High School, Kupang District-East Nusa Tenggara ................................................................. 69
  Rola Marlince Sakan, Yuli Utanto

◆ Session 3---- Children's Education

Effects of Arts Integration Approach on Parent-Child Education .................................................. 74
  Shih Meng-Chi, Tseng Chih-Feng, Chao Nai-Chia

Reality, Television, and Children in the Digital Age ...................................................................... 78
  Szu-Wei Chen

The Study of Relationship among Internet Addiction, Interpersonal Relationship and Money Attitude ...... 83
  Wan-Ling Chang, Wei-Hsin Lai, Jui-Hsiu Chang

A Needs Analysis for Education and Learning in Young Child Teaching Aid Design ......................... 89
  Chun Kuan Wu, Yann Long Lee, Meng Hsiu Lin, Chuan Po Wang, Kuei To Wang

◆ Session 4---- Blended Learning

Blended Learning Supports in Chinese Architectures with 360 Degree VR Contents and 3D Modelling VR Contents ................................................................. 94
  Siu Wo Tarloff Im, Pit Ho Patrio Chiu, Lin Li

Research on the Effectiveness of Producing Virtual Reality Film and Teaching with Thao Festival Culture and Ceremony as the Case Subject ................................................................. 99
  Cheng-Hui Tsai, Chuan-Po Wang

Gen X STEM Teachers’ Perceived Usefulness and Challenges of a Blended-Learning System.......... 104
  Thanakrit Maleesut, Poramin Piyawattanaviroj, Pratchayapong Yasri

The Effects of Online Activities on Student Learning Outcomes in Blended Learning Environment........ 107
  Herman D Surjono, Ali Muhtadi, Novi Trilisiana

Enhancing Students Engagement in IATA Classes using Blended Learning Strategy ....................... 111
  Mohamed Darma Khairiree

◆ Session 5---- Teacher Education

Incorporating Remap-STAD Into Learning Cycle 5E to Improve Preservice Biology Teachers’ Critical Thinking Skills ................................................................. 114
  Andi Andariana, Siti Zubaidah, Susriyati Mahanal, Endang Suarsini
The Development of Teaching Skills Using ICT in Teacher Training: Practices in First-Year Introduction for ICT

Hitomi Saito, Kyoko Umeda

Factors Considered by Preschool Teachers Regarding Field Trips and the Learning Effectiveness of Field Trips

Jiun De Tsao, Yu-Ting Lin

Support of Teacher’s Work in the Field of Development of Computational Thinking Through E-Learning Resources

Tomáš Dragon

◆ Session 6---Teaching Evaluation and Technology

The Objective Structured Clinical Examination (Osce) In High-Fidelity Simulations for Assessing Nursing Students’ Clinical Judgment

Hao Bin Yuan

Applying Eye Tracking to Identify Students’ Use of Learning Strategies in Understanding Program Code


Continuous Integration for Android Application Development and Training

Phan Duy Hung, Do Thai Giang

Exploring the Relationship of Sports APPs Users’ Motivation, Goal Orientation and Exercise Involvement among College Students in Taiwan

Chin-Cheng Yang, Kai-Yu Tang, Wei-Yeng Sta, Jui-Hsio Chang

A Study on the Behavior of Watching the Broadcast of the Judo Competition of Judo Players

Chi-Yueh Hsu, Ting-I Lee, Ming-Yueh Wang, Yu-Ying Chang, Yu-Ting Chen

◆ Session 7---Educational Psychology

Impact of Student-Instructor Relationships on Affective Learning and Test Anxiety Perceptions

Elaine Yong

Identifying Students’ Mental Model for Java Programming Subject

Retno Indah Rokhmanwati, Hanifah Muslimah Az-zahra

Applying the Meta-cognitive Strategy to Chinese Reading Teaching Effectiveness

Tsui-Fung Huang, Shu-Chuan Cho, Kuei-Chien Chiu, Chih-Hung Chou, Sheng-Chieh Chou

◆ Session 8---Educational Research and Assessment

Correlations Analysis of Self-Motivation and Time Management on Academic Procrastination in Students of Public Junior High School of Malang

Handita Widhi Atma, Dany Moenindyah Handarini, Adi Atmoko

End-Of-Life Simulation Improve Nursing Undergraduates’ Self-Efficacy in Palliative Care

Yan Wang
Agile Scrum in Monitoring DepEd’s Programs, Projects and Activities (PPA): A Process Model in the Implementation of School Improvement Plan (SIP) ................................................................. 184
Maricel A. Timbal

Approaches and Measures to Educational Assessment Reform through an Internet+ Perspective ........... 190
Wenmei Zhang, Wenxiang Fan, Yichun Zhang

Using OER through Open Educational Practices To Enhance Creative Problem Solving Skills............... 197
Phantipa Amornrit

Machines Learning Trends, Perspectives and Prospects in Education Sector ........................................ 201
Nasir Abdul Jalil, Ha Jin Hwang, Norazryana Mat Dawi

Attitudes Toward Using E-Courseware in A Flipped Classroom Teaching And Learning Approach of Suranaree University of Technology Students in The Application Of Biotechnology In Crop Production Course ........................................................................................................... 206
Piyada Alisha Tantasawat, Suthinee Srisawat, Narudol Damsugree, Amornthep Thepwichit, Panlada Tittabutr

Evaluating a Mobile Tablet Project in Rural South Africa against Criteria to Comply with Being an Innovative Educational Ecosystem ........................................................................................................... 215
Marlien Herselman, Adele Botha, Keneilwe Maremi

Session 9--- Course Design

Study on the Performance of Students’ Autonomous Learning from the Course Planning of Design Department .......................................................................................................................... 221
Tsu-Wu Hu, Shin-Tai Chu, Ku-Hsi Chu

The Hands-On STEM Curriculum Design Promoting Science Learning and Career Self-Efficacy for Gifted Girls ...................................................................................................................... 225
Hsiao-Ping Yu, Hong-Yi Chen, Yu-Lim Chen

Participation in Curriculum Development of Senior Community Learning: An Inquiry into the Responses of Teachers .......................................................................................................................... 229
Wei-Chieh Yeh, Yu-Chen Chien, Tai-Shen Huan

The Practice of Quality Course Construction for Postgraduate Students Based on Modern Educational Technology-Taking Modern communication Theory course Reform as an Example .................. 234
Yinghui Kong, Zhixiong Chen, Ping Yu

The Construction and Development of Digital Electronic Technology Course Majoring in Applied Electronic Technology of Advanced Vocational College .................................................................................. 239
Yi Tian

An Empirical Study on the Motives of Foreign Students Studying in China for China’s MBBS Programs——Taking the West China School of Medicine, SCU as an example ........................................... 245
Yuanyuan Li, Yiru Wang, Xuehong Wan

Session 10--- Special Education
<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Virtual Teaching</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The Use of Augmented Reality to Represent Gamification Theory in User Story Training</td>
<td>265</td>
</tr>
<tr>
<td></td>
<td>The Difficulties and Countermeasures of Applying Virtual Reality to Industrial Design Education</td>
<td>269</td>
</tr>
<tr>
<td></td>
<td>Virtual Exhibition as Learning Media in Landeskunde Teaching for German as a Foreign Language</td>
<td>273</td>
</tr>
<tr>
<td>12</td>
<td>School Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Managerial Capabilities of Headmaster in Improving Teacher Performance</td>
<td>278</td>
</tr>
<tr>
<td></td>
<td>Visualization and Analysis of Research Field in University Laboratories by Text Mining</td>
<td>283</td>
</tr>
<tr>
<td></td>
<td>Educational Marketing Strategy Through Online Platform: A Case of SSRUIIC, Thailand</td>
<td>287</td>
</tr>
<tr>
<td></td>
<td>A Comparative Analysis of Information Provided in the Universities’ Website for International Students: Malaysian Public and Private Universities</td>
<td>291</td>
</tr>
<tr>
<td>13</td>
<td>Mobile Learning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Understanding Factors Affecting the Use of English Writing Software in Indonesia</td>
<td>297</td>
</tr>
<tr>
<td></td>
<td>An Interactive Mobile Technology to Improve the Usability of Exam Application for Disabled Student</td>
<td>302</td>
</tr>
<tr>
<td></td>
<td>Mobile Learning Based on Remote Experimental Teaching Platform</td>
<td>307</td>
</tr>
<tr>
<td></td>
<td>Hanasu: Interactive Japanese Language M-Learning Application to Support Listening and Speaking Exercise</td>
<td>311</td>
</tr>
</tbody>
</table>
Using Mobile Application for Word Reordering Problems to Enhance Learning Analytics.......................... 316
Xueliang Chen, Yoshinori Miyazaki

Session 14---Marketing and Management

The Impact of Brand Positioning and Information on Emotional and Behavioral Participation of Social Media .................................................................................................................. 321
Yulin Chen

Digital Media Technology as an Instrument for Promotion and Political Marketing in the Era of Industrial Revolution 4.0........................................................................................................... 327
Gatut Priyowidodo, Inri Inggrit Yustisia D.Sari, Samuel Gunawan

The Backpacking Travelers’ Usage Value and Experience on Tourism Efficiency by Using Travel Apps. 332
Ting-I Lee, Ming-Yueh Wang, Chi-Yueh Hsu, Yu-Ting Chen, Chun-Yu Chien

Assessment of the Factors Affecting People’s Satisfaction towards the Service Quality of Phutthamonthon Police Station, Nakhon Pathom Province .................................................................................................................. 336
Bhuk Kiranantawat

Optimization in the Sugar Transport Process Case Study: Thai Sugar Terminal Public Company Limited. 341
Piyaon Sriwan

Session 15---Linguistics

Specialised Corpus Development on Aviation Disasters News Discourse ........................................................................................................ 345
Sarimah Shamsudin, Wan Najmiyyah Wan Md Adnan

Corpus-based Analysis of MH17 Online Dutch News Articles.................................................................................................................. 350
Wan Najmiyyah Wan Md Adnan, Sarimah Shamsudin

Session 16----Innovation of Teaching Methods

Teaching Agile Methodology through Role-Playing: What to Expect and What to Watch Out......................... 355
Rex Bringula, Reynalyn Elon, Laurenz Melosantos, Jose Rudolfo Tarrosa

Implementation of a Social Constructivist Educational Model and a Significant Learning for the Development of Video Games for the Teaching of Colombia Caribbean Art ................................................................................. 360
Nataly Riaño Carmona

Integrating Computational Thinking into the Process of Learning Artificial Intelligence .................................................................................................................. 364
Wen-Chung Shih

An Effective Learning Model Derived from Integration Problem-Based Learning and Digital Mind Maps to Enhance Students’ Creativity ........................................................................................................... 369
Nurkhairo Hidayati, Siti Zubaidah, Endang Suarsini, Henry Praherdhiono

The Integrated Problem Based Learning and Predict, Observe, Explain (PBL-POE) to Empower Students’ Problem-Solving Skills ........................................................................................................ 375
Apriza Fitriani, Siti Zubaidah, Herawati Susilo, Mimien Henie Irawati Al Muhdhar
✧ An Educational Card Game for Enhancing Students’ Learning of the Periodic Table ........................................ 380
   Poramin Piyawattanaviroj, Thanakrit Maleesut, Pratchayapong Yasri
✧ Significance of Dynamic Difficulty Adjustment in Delivering Instructional Scaffolding on Educational Game for High School Chemistry Subject ................................................................. 384
   Ahmad Afif Supianto, Muhammad Hafis, Herman Tolle
✧ An Innovative Learning Approach to Gerontological Nursing ........................................................................ 389
   HSU, Mei Hua Kerry
✧ An Investigation of Reasoning Skills through Problem Based Learning ............................................................. 393
   Husnul Chatimah
✧ Used Poor Theatre in Chinese Classical Language Reading Teaching Design and Effectiveness-Use Zuo Zhuan as an Example ........................................................................................................ 396
   Shu-Chuan Cho, Tsui-Feng Huang, Sheng-Chieh Chou, Chih-Hung Chou, Ching-Te Lin
✧ The English Teaching Strategies of Competitiveness and Cooperation in Gamification ................................. 400
   Hsiu-Lien Tu, Li-Wen Huang
Preface

This volume contains papers presented at 2019 3rd International Conference on Education and Multimedia Technology (ICEMT 2019), which was held in Nagoya, Japan during July 22-25, 2019.

ICEMT provides a scientific platform for both local and international scientists, engineers and technologists who work in all aspects of Education and Multimedia Technology. The volume includes 84 selected papers which were submitted to the conference from universities, research institutes and industries. These papers cover the topics range from Educational Research and Practice, Special Education, E-Learning and Information Technology and Education. Each contributed paper has gone through a rigorous blind peer-review process. The proceedings tend to present to the readers the newest researches’ results and findings in the related fields.

We invited Prof. Joy Kutaka-Kennedy, National University, USA, to give a keynote speech, entitled “The Future of Multimedia Technology in Education”; Assoc. Prof. Eric C.K. Cheng, The Education University of Hong Kong, Hong Kong for “Knowledge Management in Higher Education Institutes: Promoting Video-Based Learning Communities in a Teacher Education University”; and Prof. Budsaba Kanoksilapatham, for “Local Thai Culture Represented in English Multimedia Teaching Materials for Young Learners”. Their excellent speeches were well received by the audience and great contributions to this conference.

Meanwhile, we sincerely thank the contributions made by session chairs and reviewers. The chairperson of each session played an important role in guiding the sessions in a timely and efficient manner. Furthermore, the success of this conference could not be done without the reviewers, who volunteered their time in helping select high quality papers and provided invaluable constructive criticism to improve these papers.

We truly believe that the participants will find the discussion fruitful and enjoy the opportunity for setting up future collaborations.

Best Regards

Joy Kutaka-Kennedy
Conference Chair
Prof. Joy Kutaka-Kennedy, National University, USA
Conference Committees

Conference Chairs
Prof. Joy Kutaka-Kennedy, National University, USA

Chairs of Program Committees
Assoc. Prof. Umeda Kyoko, Aichi University of Education, Japan
Prof. Budsaba Kanoksilapatham, Silpakorn University, Thailand

Conference Technical Committees
Prof. Wei-Tsong Wang, National Cheng Kung University, Taiwan
Dr. Richard DLC Gonzales, University of Santo Tomas, Philippines
Assoc. Prof. Anabelie V. Valdez, Mindanao State University, Philippines
Dr. Daisy Jane C. Orcullo, University Utara Malaysia, Malaysia
Dr. Malini Ganapathy, Universiti Sains Malaysia, Malaysia
Assoc. Prof. Khoo Yin Yin, Universiti Pendidikan Sultan Idris, Malaysia
Lecturer Kiattichai Saitakham, Chiangmai Rajabhat University, Thailand
Assoc. Prof. Aryusmar, Universitas Bina Nusantara, Indonesia
Prof. Hui-Fang Shang, I-Shou University, Taiwan
Assoc. Prof. Artemus G. Cruz, Polytechnic University of the Philippines-Bansud Campus, Philippines
Assoc. Prof. Chalabhorn Suwansumrit, Sukhothai Thammathirat Open University, Thailand
Asst. Prof. Szu-Wei Chen, National Taipei University of Education, Taiwan
Dr. Emad A. S. Abu-Ayyash, British University in Dubai, UAE
Dr. Ahmad Zabidi Bin Abdul Razak, University of Malaya, Malaysia
Prof. Nadia Tazi, Arabian Gulf University, Bahrain
Assoc. Prof. Faten Saad Mahmoud Abdel-Hameed, University of Bahrain, Bahrain
Dr. Ho-ying Holly Chung, Hang Seng Management College, Hong Kong
Prof. Jon-Chao Hong, National Taiwan Normal University, Taiwan
Dr. Liviu Octavian Mafteiu-Scai, West University of Timisoara, Romania
Assoc. Prof. Sylvia Sao Leng IEONG, University of Macau, China
Dr. Mah Boon Yih, UiTM, Malaysia
Dr. Gurmukh Singh, Fredonia State University, USA
Asst. Prof. Yuchun Zhou, Ohio University, USA
Prof. Chien-Chih Wang, Ming Chi University of Technology, Taiwan
Dr. Edmond WM LAM, The Hong Kong Polytechnic University, Hong Kong
Dr. Arbaayah Ali Termizi, Universiti Putra Malaysia, Malaysia
Dr. Chin Kin Eng, Flinders University, Australia
Prof. Jay Rajasekera, Tokyo International University, Japan
Prof. Hiroko Kanoh, Yamagata University, Japan
Dr. Jeya Amantha, Universiti Sains Malaysia, Malaysia
Prof. Christos Bouras, University Of Patras, Greece
Assoc. Prof. Aryusmar, Bina Nusantara University, Indonesia
Dr. Hao Bin Yuan, Macao Polytechnic Institute, Macao
Dr. Gary Cheng, The Education University of Hong Kong, Hong Kong
Prof. Wen-Chung Shih, Asia University, Taiwan
Prof. Chuan-Po Wang, Chaoyang University of Technology, Taiwan
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer Elaine Yong</td>
<td>Sunway University, Malaysia</td>
</tr>
<tr>
<td>Lecturer Yan Wang</td>
<td>Macao Polytechnic Institute, Macao</td>
</tr>
<tr>
<td>Prof. Hsiao-ping Yu</td>
<td>National Taiwan Normal University, Taiwan</td>
</tr>
<tr>
<td>Dr. Rahimah Jamaluddin</td>
<td>Universiti Putra Malaysia, Malaysia</td>
</tr>
<tr>
<td>Assoc. Prof. Wang Xin</td>
<td>Macao Polytechnic Institute, Macao</td>
</tr>
<tr>
<td>Asst. Prof. Janchai Yingprayoon</td>
<td>Suan Sunandha Rajabhat University, Thailand</td>
</tr>
<tr>
<td>Prof. Tsu-Wu Hu</td>
<td>Chaoyang University of Technology, Taiwan</td>
</tr>
<tr>
<td>Dr. Phantipa Amornrit</td>
<td>Sukhothai Thammathirat Open University, Thailand</td>
</tr>
<tr>
<td>Prof. Tzu-Ling Wang</td>
<td>National Tsing Hua University, Taiwan</td>
</tr>
<tr>
<td>Asst. Prof. Kang Jong Hyuk</td>
<td>The Education University of Hong Kong, Hong Kong</td>
</tr>
<tr>
<td>David</td>
<td></td>
</tr>
<tr>
<td>Prof. Tao Feng</td>
<td>Nankai University, China</td>
</tr>
<tr>
<td>Dr. Nasir Abdul Jalil</td>
<td>Sunway University, Malaysia</td>
</tr>
<tr>
<td>Prof. Syuan Lan Shih</td>
<td>Chaoyang University of Technology, Taiwan</td>
</tr>
<tr>
<td>Prof. Wei-Ting Hsu</td>
<td>Fo Guang University, Taiwan</td>
</tr>
<tr>
<td>Dr. Jiun-De Tsao</td>
<td>Chaoyang University of Technology, Taiwan</td>
</tr>
<tr>
<td>Asst. Prof. Phongthanat Sae-Joo</td>
<td>Khon Kaen University, Thailand</td>
</tr>
<tr>
<td>Prof. Qiufeng Shang</td>
<td>North China Electric Power University, China</td>
</tr>
<tr>
<td>Prof. Yinghui Kong</td>
<td>North China Electric Power University, China</td>
</tr>
<tr>
<td>Prof. Pingshui Wang</td>
<td>Anhui University of Finance and Economics, China</td>
</tr>
<tr>
<td>Assoc. Prof. Zhang Shujie</td>
<td>University of Petroleum, China</td>
</tr>
<tr>
<td>Dr. Pratchayapong Yasri</td>
<td>Mahidol University International Demonstration School, Thailand</td>
</tr>
<tr>
<td>Dr. Kemmanat Mingsritham</td>
<td>Sukhothai Thammathirat Open University, Thailand</td>
</tr>
<tr>
<td>Asst. Prof. Cheng-Hui Tsai</td>
<td>National Taichung University of Science and Technology, Taiwan</td>
</tr>
<tr>
<td>Assoc. Prof. Sarimah Shamsudin</td>
<td>Universiti Teknologi Malaysia, Malaysia</td>
</tr>
<tr>
<td>Dr. Jui-Hsiu Chang</td>
<td>Chaoyang University of Technology, Taiwan</td>
</tr>
</tbody>
</table>
An Effective Learning Model Derived from Integration Problem-Based Learning and Digital Mind Maps to Enhance Students’ Creativity

Nurkhaire Hidayati
Universitas Negeri Malang,
Universitas Islam Riau
Jalan Semarang No. 5 Malang, East Java, Indonesia
+62 341 588077
khairobio@edu.uir.ac.id

Endang Suarsini
Universitas Negeri Malang
Jalan Semarang No. 5 Malang, East Java, Indonesia
+62 341 588077
endang.Suarsini.fmipa@um.ac.id

Siti Zubaidah
Universitas Negeri Malang
Jalan Semarang No. 5 Malang, East Java, Indonesia
+62 341 588077
siti.zubaidah.fmipa@um.ac.id

Henry Praherdhiono
Universitas Negeri Malang
Jalan Semarang No. 5 Malang, East Java, Indonesia
+62 341 588077
henry.praherdhiono.fip@um.ac.id

ABSTRACT
In the present study, Problem-Based Learning and Digital Mind Maps (PBLDMM) were integrated to enhance five aspects of creativity that are originality, elaboration, fluency, flexibility, and risk-taking. This study adopted the Plomp research and development model which was performed in three stages; (1) the preliminary research phase, (2) development or prototyping phase, and (3) assessment phase. Course outline, lesson plans, student worksheets, and a checklist were developed to evaluate the implementation of the learning model. The effect of the learning model on students’ creativity was analyzed using N-Gain, while the model’s reliability was examined using regression analysis. The results showed that the PBLDMM model was valid (3.78) and had been consistently implemented in the classroom (F = 48.71). Students’ responses (81.05) towards PBLDMM also confirmed the practicality of the learning model. The significant improvement in students’ creativity was shown by the average pretest score (38.77) and posttest score (63.31) with N-Gain (0.41). This study has proven that PBLDMM model is valid, practical and effective in enhancing students’ creativity.

CCS Concepts
• Applied computing ➔ Education ➔ Collaborative learning.

Keywords
Creativity; Digital Mind Maps; Problem-Based Learning

1. INTRODUCTION
Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

ICEMT 2019, July 22 – 25, 2019, Nagoya, Japan
© 2019 Association for Computing Machinery.
ACM ISBN 978-1-4503-7210-7/19/07...$15.00
https://doi.org/10.1145/3345120.3345138

The rapid development of the 21st century has brought a significant impact on the workforce. The demand for innovative and creative workers has actually increased [1]. Therefore, as an education provider, universities have a responsibility to design learning that is able to empower and enhance the creativity of students so that they are able to compete in the work field [2]. The design of learning should facilitate the stimulation of students’ eagerness to discover, understand, analyze and apply knowledge in new situations [3] and the development of students’ high-order thinking skills [4] because information memorization will not be able to empower creativity [5].

Being creative means being able to produce new products by involving interactions between capabilities and processes [6]. Creativity can also be interpreted as the act of developing new solutions [7] by examining separate concepts [8]. Creativity starts from the exploration of ideas so that ideas become the basis of creativity [9]. Mishra, Yadav, & Deep-Play Research Group [10] put novelty, effectiveness, and wholeness as key parts of creativity. Creativity does not only involve cognitive dimensions but also relates to common skills needed in everyday life such as ideas association, perceptions, analytical thinking, and structured problem discovery [11].

Creativity plays a crucial role in the 21st century as it triggers the advancement of civilization [12]. New ideas and new ways have been discovered to improve the productivity and standard of living. In fact, one’s creativity can determine his/her success [13] because creativity may help him/her respond to and resolve complex problems [6]. Therefore, higher education needs to facilitate the development of students’ creativity.

However, low-creativity students have been identified in some parts of Indonesia [14, 15]. The students’ poor performance in creativity may be affected by the learning atmosphere that does not facilitate students’ freedom in expressing ideas [13]. Instead, learning is mostly focused on acquiring knowledge through memorization [16]. Thus, it can be concluded that learning models implemented in the classrooms have not been effective in empowering the students’ creativity [17]. One of the examples of effective learning models that can improve students’ creativity is Problem-Solving Learning (PBL). PBL introduces real-world
problems to students. It also allows students to evaluate and reflect on the problem-solving process [18, 19].

A number of studies have reported the effectiveness of PBL in promoting creativity in the classroom [20, 21] despite some insignificant improvements in certain aspects of creativity. For example, Sihaloho, Sathy, & Ginting [22] showed that PBL and conventional only differed by 0.06 points in fluency and 0.38 points in flexibility. Other studies reported no significant difference between PBL and conventional in originality and scientific knowledge [23, 24].

As an active learning model, PBL consists of beneficial activities, but the shortcomings of the model have also been observed in PBL classrooms, such as the students’ unpreparedness and lack of interest in studying the materials [25]. Since problems introduced in PBL are not always diverse and since some details might be slipped from the teacher's delivery of instruction, the students are unable to master the topics in their entirety [26, 27]. In addition to that, Moutinho, Torres, Jonana, Fernandez, & Vasconcelos [28] explained that PBL had not been able to develop students’ creativity related to the nature of science.

These shortcomings can be overcome by incorporating mind mapping into PBL. A mind map is a representation of one’s thoughts. It can be created using a graphic design [29]. Mind maps can be developed in a digital form. Digital mind maps (DMM) integrate the use of information technology in mind-mapping. Through DMM, students can represent their ideas using images, colors, and interesting fonts [30, 31].

The integration of PBL and DMM as active learning is expected to be able to improve university students’ creativity. Digital mind-mapping encompasses brainstorming activity and deep analysis of materials so that a connection between concepts can be established [29]. Students’ creativity can be boosted through the creation of a combined fascinating concept-image [31]. Envisaging the significance of integrating DMM into PBL in improving students’ creativity, the current study thus aimed to develop the integrated Problem-Based Learning and Digital Mind Maps (Integrated PBLDMM) model.

2. METHOD

2.1 Research Design

The Plomp [32] research and development design was used in this study. It consisted of three following stages: (1) preliminary research phase, (2) development or prototyping phase, and (3) assessment phase. A group of students from the Department of Biology, Islamic University of Riau, who were studying Human Anatomy and Physiology, were involved as the subjects.

2.2 Research Instruments

The development of the research instruments and the data collection procedures was adjusted to the purpose of each development stage:

2.2.1 Preliminary Research

An interview and observation were performed to analyze learning activities. A questionnaire was also distributed to the students to elicit their responses. The findings were then used as the basis of the development of the learning model prototype. A literature review was also conducted at this stage.

2.2.2 Development or Prototyping

In the second phase, a model book and learning tools were designed. Course outline, lesson plans, student worksheet, and assessment rubric were developed as the tools to facilitate the learning process. A tryout was conducted to the prototype and the learning tools. Validation sheets and learning tools were the instruments used in this phase.

2.2.3 Assessment

To investigate the practicality and effectiveness of the model in improving students’ creativity, it was tried out to a group of biology students for one semester. The instruments used at this stage were observation sheets, a questionnaire, and a creativity test. The creativity test had been confirmed valid (a significance level of 0.000) and reliable (0.75) using Cronbach's Alpha.

2.3 Data Analysis

Data obtained using the validation sheet were analyzed descriptively. The results of the analysis showed the validity of the model based on the following categories: invalid (1.00 ≤ V \_\_ ≤ 1.60); less valid (1.60 < V \_\_ ≤ 2.20); moderately valid (2.20 < V \_\_ ≤ 2.80); valid (2.80 < V \_\_ ≤ 3.40); and highly valid (3.40 < V \_\_ ≤ 4.00). In addition, the practicality of the model was analyzed using a regression test, while the effectiveness of the model was examined using N-Gain. The results of the N-Gain analysis were described in three categories: high (g > 0.7), medium (0.3 < g ≤ 0.7), and low (g ≤ 0.3).

3. RESEARCH FINDING

3.1 Preliminary Research

The results of the observation showed that the majority of the students were “not ready” to engage in the process of learning, so when the lecturer asked them a question, only a few of them were able to answer it. When asked, the students admitted that they never read nor studied the materials at home. Therefore, we concluded that a mind-mapping task should be given to the students to help them better understand the materials in an organized way.

The learning process, indeed, had accommodated the students’ cooperative skills. However, the task given to the students had not challenged the students’ ability to solve problems. As a result, students’ creativity had not been completely developed. The observation also showed that the students performed a lack of skills in explaining how to dive to the maximum depth of 20 meters. Their answers were mostly similar due to their unfamiliarity with the topic and inability to use creativity to cope with a certain complex problem.

These empirical findings, thus, provided insights for the study of theories underlying the process of developing the PBLDMM model. The review covered the theories of learning, learning models, and the findings of previous studies. Based on the results of the observation, interviews, survey, and literature review conducted at this stage, we finally learned how to incorporate Digital Mind Maps (DMM) into Problem-Based Learning (PBL) to produce a learning model that can empower students’ creativity.

3.2 Development or Prototyping

The design of the PBLDMM model was based on the initial study when preliminary research. This model was designed by studying the PBL model phase and mind maps used in the learning process.

<table>
<thead>
<tr>
<th>No</th>
<th>Aspects to Evaluate</th>
<th>Average Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rationalization of model</td>
<td>4 (highly valid)</td>
</tr>
</tbody>
</table>
The results of the analysis showed that both lines were linear (not overlapping). It indicated that the PBLDMM model had a consistent feasibility pattern, where $F_{\text{calculated}}$ of linearity was 2.44 (a significance level of 0.12 (> 0.05)) and $F_{\text{calculated}}$ of overlap was 4.89 (a significance level of 0.01 (< 0.05)). The effectiveness of the model in improving students’ creativity was examined using N-Gain (Table 3).

Prior to the implementation stage, the design of the learning model was discussed with some experts. The experts were invited to provide feedback and suggestions on several aspects (Table 1) and the design of the learning is presented in Table 2.

**Table 2. The Phases of learning in PBLDMM**

<table>
<thead>
<tr>
<th>No</th>
<th>Phase</th>
<th>Learning Activities</th>
<th>Student</th>
</tr>
</thead>
</table>
| 1  | Review of prior knowledge and the building of connection between the knowledge to the materials being learned using DMM | a. Asks students to present their DMM  
b. Asks some questions related to the concepts written on the DMM  
c. Explains the learning objective(s) | a. Pays attention to the DMM and the lecturer’s explanation  
b. Provides answers to the lecturer’s questions  
c. Listen to the lecturer’s explanation |
| 2  | The orientation of the problem                                       | Introduces students to the problem(s) by presenting some actual issues            | Listens to the lecturer’s explanation and attempts to formulate the problem(s) |
| 3  | Students’ organization                                                | a. Assigns students to work in groups  
b. Helps students to define the task(s)  
c. Asks students to prepare learning resources | a. Sits in groups  
b. Prepares the task(s) in groups  
c. Prepares all references relevant |
| 4  | Individual or group investigation                                    | a. Motivates students to gather information  
b. Asks students to discuss the problem(s) | a. Collects relevant information  
b. Discusses the solution(s) |
| 5  | Presentation of the results of the investigation and the addition of more details into the DMM | a. Asks students to write down the information  
b. Asks students to utilize the information to enrich their DMM  
c. Asks students to present their work  
d. Opens a discussion after the presentation | a. Writes a report that contains problem(s) and the solution(s)  
b. Adds new information to the DMM  
c. Presents the result  
d. Be ready for the question and answer |
| 6  | Analysis and evaluation of the problem-solving process               | a. Directs students to do reflection or evaluation  
b. Provides reinforcement  
c. Wraps up the lesson and assigns them a DMM task as homework | a. Reflects or evaluates the problem-solving process  
b. Listens to the lecturer’s explanation  
c. Listens to the lecturer’s explanation |

**3.3 Assessment**

The PBLDMM model was implemented for six months. The practicality test results can be seen in Figure 1.

![Figure 1. The Results of Regression PBLDMM Model](image)

The results of the analysis showed that both lines were linear (not overlapping). It indicated that the PBLDMM model had a consistent feasibility pattern, where $F_{\text{calculated}}$ of linearity was 2.44 (a significance level of 0.12 (> 0.05)) and $F_{\text{calculated}}$ of overlap was 4.89 (a significance level of 0.01 (< 0.05)). The effectiveness of the model in improving students’ creativity was examined using N-Gain (Table 3).

**Table 3. The Results of the N-Gain Analysis**

<table>
<thead>
<tr>
<th>Score</th>
<th>Pretest</th>
<th>Posttest</th>
<th>N-Gain</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38.77</td>
<td>63.31</td>
<td>0.41</td>
<td>Medium</td>
</tr>
</tbody>
</table>

The results of the N-Gain analysis presented in Table 3 showed that there was a difference in the students’ creativity scores before and after the implementation of the PBLDMM model. The N-Gain score was categorized into the medium category (0.41).
4. DISCUSSION
The Integrated PBLDMM model developed in this study has been proven valid. Validity is one of the key aspects of Research and Development since it indicated the ability of an instrument to measure what it is supposed to measure [33]. The validity of the PBLDMM model in general covers the validity of the rationale for developing the model, of theories underlying the development of the model, of the components of the model, and of the language used.

The experts were invited to provide feedback and suggestions for improving the prototype. Some of the experts' advice is related to the addition of recent learning theories and more detailed explanation on teacher's and students' responses to the components of the model reaction principle. Based on the experts' suggestions, it can be concluded that theories underlying the model development consist of constructivism theory, social-cognitive theory, socio-cultural theory, and information acquisition theory. Learning theories which attempt to describe how humans learn help construct an understanding of a complex process of learning [34]. In this case, each of the learning theories mentioned earlier supports the phases of learning in PBLDMM model. They are explained as follows.

The first phase encourages students to create a DMM by connecting their prior knowledge to the materials being learned. The constructivism theory underlying the activity mentions that learners build their understanding based on individual experiences and implement this knowledge directly to their surrounding [35, 36]. The second phase is the orientation of problems. The foundation of this phase is Bruner’s theory. This theory explains that, in order for learning to be effective, educators should provide scaffolding. Normally, this type of learning is carried out with certain patterns such as beginning the lesson with an inquiry from the instructor [37].

The third phase is the students' organization. Cooperative learning activity conducted at this phase is based on the cognitive apprenticeship concept. In the groups, students create an interaction which facilitates the exchange of ideas [38]. The fourth phase is guided individual or group investigation. Bandura [39] through his cognitive social theory argues that people learn from observing other people and the environment. Therefore, the teacher’s or instructor’s assistance is crucial in this phase.

The fifth phase is to develop the existing DMM by adding more details to it and to present the result. The practice of delivering a presentation is inseparable from the use of language. Thus, this phase basically refers to the socio-cultural theory which suggests that language enables social interactions to exist and one’s thoughts to be understood [40]. The sixth is the analysis and evaluation of the problem-solving process. The experiential learning theory suggested by Kolb [41] underlying this activity suggests that all experiences gained by students in the learning process will be one of the guides for students to act in the future.

The practicality of the PBLDMM model was examined by determining the model into the field. The results showed that the feasibility pattern of PBLDMM was consistent. Consistency refers to the continuous and right implementation of the model [42]. Since all the procedures to conduct PBLDMM learning has been written in an organized manner in the guidance book, the lecturer could perform learning based on the order.

Student responses to the PBLDMM model are also very positive. Students feel motivated to learn more about the materials being studied with the use of DMM. Problem orientation can help students find solutions in group discussions. Students also claim to be able to convey ideas systematically. The various advantages found in the Integrated PBLDMM model are in accordance with the explanation of Chan and Yuen [17] who state that flexible learning conditions can improve students' creativity. In addition, the use of DMM with attractive graphics representation can also help students brainstorm ideas and concepts [31].

The effectiveness of the PBLDMM model was examined using N-Gain. The results of the N-Gain analysis showed that PBLDMM was effective in improving students’ creativity. In PBLDMM, students are given an opportunity to express their ideas on DMM. At the first phase, where the students are asked to draw a mind map before coming to the classroom, their creativity is challenged. They need to add as many details as possible to the DMM. This type of learning atmosphere which establishes learning flexibility and autonomy can promote students’ creative potentials. On the other hand, rigid, fixed, and scheduled learning can inhibit creativity [24].

Another reason that causes the PBLDMM model can improve creativity because in the learning process involves students in understanding the problem. Students themselves must formulate problems and find solutions. The activities can train students' thinking and creativity skills. The findings of this study are in line with previous research findings which have also proven the effectiveness of PBL in improving students' creativity [21, 24].
PBL is a learning model that is oriented to problem-solving. The existence of a problem can trigger one's deep thinking. Problem-solving involves individuals in an active search for meaningful information [43].

The effectiveness of PBL and mind map in improving creativity has been reported by many studies across disciplines [44, 45]. The goal is that the whole set of ideas can be transferred into various other situations. PBLDMM is also flexible in terms of utilizing a variety of ways of thinking, such as generating new ideas from different perspectives [2]. The PBLDMM model has been proven able to improve student creative thinking. The integration of problem-solving with the freedom of expressing ideas through DMM is the main property of PBLDMM as an active learning model. In addition to improving creativity, the PBLDMM model can also be proven to improve student learning outcomes. An overview of the results of the study that examines the PBLDMM model and learning outcomes will be presented in our other writings.

5. CONCLUSION
A valid, practical, and effective learning model has been generated in this study. This learning model is the result of the integration of Problem-Based Learning and Digital Mind Maps or the Integrated PBLDMM. The PBLDMM model has been proven effective in improving students’ creativity. Therefore, it is highly recommended to use the model in the classroom, especially at universities. In addition, it is advisable for future researchers to investigate the effectiveness of PBLDMM in improving other skills, such as critical thinking, science literacy, and many others.

6. ACKNOWLEDGEMENTS
This research was supported by the Educational Fund Management Institution (LPDP), the Ministry of Finance with number FR2712018124893, and the the Ministry of Research, Technology & Higher Education of Indonesia.
7. REFERENCES


CERTIFICATE OF PRESENTATION

2019 3rd International Conference on Education and Multimedia Technology
(ICEMT 2019)
Nagoya, Japan
July 22-25, 2019

THIS CERTIFICATE IS AWARDED TO

Paper ID: JU2050

Paper Title: An Effective Learning Model Derived from Integration Problem-Based Learning and Digital Mind Maps to Enhance Students' Creativity

Presenter’s Name: Nurkhairo Hidayati

Presenter's Affiliation: Universitas Negeri Malang, Indonesia

Conference Committee
ICEMT 2019