



BOOK OF ABSTRACT

EASE-ICMScE JOINT INTERNATIONAL CONFERENCES 2024





Joint International Conferences

East-Asian Association for Science Education (EASE) and

**International Conference on Mathematics Education and
Science Education (ICMS&E)**

Theme:

Strengthening Science and Mathematics Education as a Valuable

Foundation for Future Life to Reach
Sustainable Development Goals

Editorial Team:

Committee of EASE-ICMS&E Joint International Conference 2024

**Faculty of Mathematics and Science Education
Universitas Pendidikan Indonesia**

Bandung, July 8-9, 2024

EASE-ICMScE Joint Conference 2024

Opening Remarks



**Irma Rahma
Suwama, Ph.D.**
Chairperson

Dear honorable guests, presenters, participants, and colleagues...

I am sincerely thanking and welcome you to EASE-ICMScE Joint Conference 2024.

International Conference on Mathematics and Science Education (ICMScE) is an annual conference that has been hosted by the Faculty of Mathematics and Science Education, UPI since 2018. The conference is held to share research ideas and results and initiate collaboration among scholars.

East Asian Association for Science Education (EASE) was officially established on October 31, 2007, at the founding assembly held at Seoul National University. It was initiated by five constituent regions (China Mainland, Hong Kong, Japan, Korea, and Taiwan). Fortunately, Indonesia became a new region member since 2022. Now it is consisting of seven regions: China Mainland, Hong Kong, Japan, Korea, Taiwan, Indonesia, and Thailand. EASE has a bi-annual conference and a student short program.

This is a big opportunity and honor for UPI to combine the two conferences.

I would like to report that the joint conference attended by 321 registrants includes 256 online/offline presenters, and 65 online/offline participants. I am greatly thankful to all EASE region contributions so that we have many participants not only from all EASE regions, but also from the United States, Philippines, Malaysia, Germany, and Africa.

This year, EASE-ICMScE raised the theme of "Strengthening Science and Mathematics Education as a Valuable Foundation for Sustainable Development Goals." I hope all of us can share and discuss the ideas and research results to enrich education for Sustainable Development Goals.

I am sincerely thankful to all UPI leaders, and committees for their support and hard work. Please enjoy the conference and let's initiate further collaboration!

Best regards,

A handwritten signature in blue ink, appearing to read 'Irma', with a stylized flourish extending to the right.

Irma Rahma Suwama, Ph.D.
Chairperson

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Physics and Physics Education

ABS-ICMSCE-24005

Trends and Research Opportunities of Development Inquiry-Based Learning Models in Science Education: A Systematic Literature Network Analysis

Sunaryo Romli, Andi Suhandi, Muslim, Ida Kaniawati
Universitas Pendidikan Indonesia
sunaryoromli@upi.edu, andi_sh@upi.edu,
muslim@upi.edu, kaniawati@upi.edu

This research aims to describe research trend data related to the inquiry application in science education. Article metadata was collected from the Scopus database with the help of Publish or Perish (PoP) software, and 136 relevant articles were selected in 2015-2024. Data were analyzed using the Systematic Literature Network Analysis (SLNA) method with the VOS Viewer application. Bibliometric analysis variables such as the number of articles and citations each year, journals and authors with the most publications, countries and author collaboration networks. Data analysis was determined based on metadata, and then analyzed descriptively. This research showed that the number of science education inquiry research articles during the 2015-2024 period had fluctuated and tends to increase. The top keywords with the highest link power were science, students, and inquiry. Current research focused on models, development learning, science process skills, and science as important

keywords. Further research related to inquiry learning had the potential to be developed in science learning and focused on developing 21st-century skills. In addition, further research was able to focused on developing innovative inquiry-based learning models that were oriented toward improving students' 21st-century skills.

Keywords: Inquiry, Science Learning, Systematic Literature Network Analysis (SLNA)

ABS-ICMSCE-24011

**Mapping the Landscape of Problem-Solving in
Physics Education Research: A Bibliometric Study**

Siti Nurjanah, Nurul Aulia Martaputri, Shaufi
Ramadhani, Izzul Kiram Suardi, Endang Wati
Yogyakarta State University

siti960pasca.2023@student.uny.ac.id,

nurulaulia.2023@student.uny.ac.id,

Shaufiramadhani.2023@student.uny.ac.id,

izzul0010pasca.2023@student.uny.ac.id,

endangpuspitasari247@gmail.com

Problem-solving skills are essential for students in physics education. This study aimed to conduct a bibliometric analysis to identify trends, gaps, and future research directions in problem-solving skills in physics education. A search was performed on the Scopus database, and data analysis for 543 eligible records was conducted using Biblioshiny and VOSviewer software. The comprehensive bibliometric analysis revealed a

significant increase in research on problem-solving skills in physics education from 2018 to 2020, with crucial contributions from institutions in Indonesia and the United States. The review highlighted the emphasis on developing students' creative problem-solving abilities, conceptual understanding, and collaborative skills, as well as the integration of technology such as artificial intelligence and computer-aided instruction. The analysis identified six distinct research clusters focusing on aspects like creative problem-solving strategies, collaborative learning approaches, curriculum development, assessment and metacognition, technological integration, and student attitudes. The findings underscored the potential of integrating intelligent tutoring systems, virtual laboratories, and online tools with problem-based learning approaches to enhance students' problem-solving abilities, creativity, and metacognitive skills, ultimately contributing to the advancement of physics education. Future research could holistically integrate innovative pedagogies, cutting-edge technologies, and cross-disciplinary collaborations while also conducting longitudinal studies, developing comprehensive assessments, and ensuring the practical relevance of acquired competencies in preparing students for real-world challenges.

Keywords: Bibliometric analysis; biblioshiny; problem solving skills; scopus; vosviewer

ABS-ICMSCE-24025
**SCIENCE AND ENGINEERING PRACTICES
(SEPs): STUDENT'S PROFILE OF DEVELOPING
AND USING MODELS (DUM)**

Akrom Chasani
Universitas Riau
akrom.chasani6952@grad.unri.ac.id

The era of industrial revolution 4.0 has changed the way of thinking about education. Integration of physics science education content and practices in physics learning is very important to do. In fact, the essence of physics learning based on NGSS is to involve three learning dimensions, namely DCIs, CCs, and SEPs. This phenomenon causes students to be less directly involved in learning, especially in learning physics. Physics learning has a new framework called NGSS which stands for Next Generation Science Standard (NGSS). This research uses one of the practices in NGSS, namely developing and using models (DUM) on static fluid materials. Physics teachers have tried to make students like physics. However, students still experience difficulties in studying physics, so there is a need for exercises that make learning more meaningful. This research uses multiple choice tests to collect data. Student developing and using models data was obtained from student tests using the Two-Tier Multiple Choice (TTMC) assessment instrument. The results of the data analysis of students' DUM skills obtained test of normality results in the experimental pretest class of 0.125 and posttest of 0.124, while the results of the test of normality in the pretest control class were 0.271 and posttest were 0.266

(results using modules > without modules). In the homogeneity test used, namely Shapiro-Wilk, the significance value (p) obtained for the experimental class pretest = 0.345 and posttest = 0.246 ($p > 0.05$), while the control class pretest = 0.249 and posttest = 0.136 ($p > 0.05$) So it can be concluded that SEPs skill data is normally distributed. In the normalized N-Gain test, the N-Gain value for the SEPs skill aspect was obtained, one of which was the developing and using models aspect, with the highest increase in the SEPs aspect with an average N-Gain of 0.56. Based on the test results for several aspects, the increase in SEPs skills is because the modules used for student learning have been designed using stages associated with SEPs aspects.

Keywords: Industrial Revolution 4.0, NGSS, SEPs, TTMC, Developing and Using Models.

ABS-ICMSCE-24049

Analysis of Learning Obstacles for Vocational School Students in Definite Integrals of Algebraic Functions

Rusnan bin Tarya, Isti Hidayah, Walid

Universitas Negeri Semarang

rusnanbintarya@students.unnes.ac.id,

isti.hidayah@mail.unnes.ac.id,

walid.mat@mail.unnes.ac.id

Forever This learning integrated in vocational schools is implemented without notice problem learning encountered students, often the teacher conveys

meaningful material teach only form book text. Therefore that's important for do in- depth research challenge learning (learning Obstacle) on integral material. Learning created from challenge learning that creates a good learning process. Research purposes this is for study challenge study related with Integral material is not of course function algebra and factors the cause. Research methods This is qualitative and technical meeting the data with tests, interviews and documents written. Regarding results his research that student difficulty in the integration process as many as 58%, student's difficulty in writing Integral results as much as 58%, student's difficulty in application rule operation number leave as many as 66.7%, and as many as 83.3% of student's difficulty in method substitution.

Keywords: learning barriers, ontogenic obstacle, epistemological barriers, didactic obstacle, integral

ABS-ICMSCE-24059
**DEVELOPMENT OF LEARNING MEDIA FOR
PHYSICS MISSION CARD GAMES (MISIKA)
BASED ON CREATIVE THINKING SKILLS
INDICATORS IN STATIC FLUID MATERIALS**

Vania Valda, Ahmad Zulkarnain Zain

Universitas Pendidikan Indonesia

vaniavaldav@gmail.com, ahmadzzain@upi.edu

Physics subject, especially static fluid material, is considered difficult by students because the methods and

strategies used in teaching are less varied. A game-based learning strategy is needed to give variation in teaching, namely Physics Mission Cards (MISIKA) developed with the Creative Thinking Skills indicator. This game contains mission cards, keys and treasures equipped with virtual PhET labs and use experiment kits in school to support interactive learning. The research method used is Research and Development with 4 stages: (1) Define; (2) Design; (3) Develop; and (4) Disseminate. At the define and design stages, the MISIKA design has been made. The results of the development stage on expert validation obtained a value of "Very Good" with a value of 96.83%. Then the media tested with guided inquiry learning to 2 test groups each containing 5-6 students. These test groups obtained the results "Very Good" with a value of 90% for media validation. At the dissemination stage, the dissemination of MISIKA media is carried out through journals and other media. The result of this research is a MISIKA card that can be used for learning activities.

Keywords: Creative Thinking Skills, Learning Media, Physics Game Cards, Static Fluid.

ABS-ICMSCE-24069

**Logical Reasoning Profile of Student Teachers in
Indonesia**

Endang Susilawati

Universitas Pendidikan Indonesia

endsusiawati001@gmail.com

A descriptive study was carried out to get information about student teachers' logical thinking abilities. The

result is then can be used to prepare learning material for them. The research was conducted on first year students who took Basic Physics courses in some Universities. Their logical thinking abilities are seen from the test scores obtained in completing the Test of Logical Thinking (TOLT). The test consists of 10 questions containing five indicators, namely proportional reasoning, controlling variable, probability, correlation and combinatorial. Each indicator consists of two questions. The number of respondents in this study was 222 students spread across seven private universities. Respondents consisted of students from the Information Technology Education, Science Education and Physics Education study programs. The research results show that 62% of respondents are still at the concrete operational level, 27% are at the transitional level, and only 11% of respondents are at the formal operational level. The results of the analysis of each indicator of logical reasoning are generally still relatively low. The highest indicator that students can achieve is the proportional reasoning indicator, while the lowest is the combinatorial indicator. Reasoning level analysis was also carried out based on majors in high school. Based on the results of the analysis, it is known that whether students have a science or non-science background, the students' level of logical reasoning is dominant at the concrete operation level. Meanwhile, students' achievements in logical reasoning indicators based on majors in high school are the same as the results for all students. The achievements of good reasoning indicators from science and non-science majors, respectively from highest to lowest, are proportional reasoning, correlational reasoning,

probabilistic reasoning, controlling variables, and finally combinatorial reasoning.

Keywords: Logical Reasoning, Student Teachers

ABS-ICMSCE-24070

**The Importance of Developing Statistical Physics
Lecture Models in Improving Mental Models and
Problem Solving Skills**

Hazrati Ashel, Ida Hamidah, Sjaeful Anwar, Muslim
Universitas Pendidikan Indonesia
hazratiashel@upi.edu, idahamidah@upi.edu

This research aims to describe the importance of innovating the Statistical Physics lecture model in improving mental models and improving problem solving skills. Data was collected through analysis of lecture documents, survey questionnaire from 76 students at one of the universities in Padang City, and an open questionnaire from 4 lecturers teaching the Statistical Physics course. The results of the analysis show that the Statistical Physics lectures have carried out active learning by applying several lecture methods such as lectures, discussions, and presentations. Several lecture models have also been used. However, there are still many students who experience difficulties in studying. This is because these models cannot support abstract material and are difficult to carry out experiments directly. One of the solutions provided is to integrate argumentation-based learning and three levels of representation in Statistical

Physics lectures. Lecturers and students agree that arguments based on three levels of representation can help and make it easier for them to produce appropriate explanations when given problems.

Keywords: Developing Models, Statistical Physics, Mental Models, Problem Solving Skills.

ABS-ICMSCE-24079

Two Decades of Research on Physics Mobile Learning: A Bibliometrics Analysis

Sri Zakiyah, Irma Rahma Suwarma, Dadi Rusdiana
Universitas Pendidikan Indonesia
srizakiyah1709@gmail.com, irma.rs@upi.edu,
dadi_rusdiana@upi.edu

Mobile technology integration in physics education has become an increasingly popular study area in recent years. However, a publication on scientific evaluation that employs bibliometric report analysis to identify this field's research foci and scientific overview is currently absent. In this study, we perform a bibliometric analysis of the scientific literature on physics mobile learning research. We aim to obtain information on scientific output, relevant sources, highly active authors and nations, research partnerships, and research subjects. Two hundred seventy-two documents were retrieved from the Scopus database, spanning 2002 to 2023. The primary results reveal a consistent growth in the scholarly output of physics mobile learning research over the last two

decades. Furthermore, they also demonstrate a change in the emphasis of research. Recently, there has been a significant increase in the importance of empirical studies investigating the effects of physics mobile learning, which incorporates learning models, on students. Conversely, most earlier published publications have concentrated on the design of ubiquitous-based tools for teaching physics.

Keywords: mobile learning, bibliometric analysis, physics

ABS-ICMSCE-24081

**Empowering Traditional Ecological Knowledge
through Project Based Learning Models to
Enhancing Students' Environmental Literacy**

Diana Zulyetti

Universitas Negeri Padang
dianazulyetti@gmail.com

Traditional Ecological Knowledge can be understood as the body of knowledge a given population has concerning the ecological aspects of the environment in which it lives and its various practical implications. It is necessary to introduce and empower the indigenous people knowledge to student through the education so student have the attitude and behavior in protecting their environment. This study aimed to determine the effect of the Project Based Learning (PjBL) models based on Traditional Ecological Knowledge (TEK) ikan larangan dan hutan larangan on student's environmental literacy. This type of

research was a quasi-experimental pretest only group design study. The research sample are 60 students of class E phase SMAN 1 Lareh Sago Halaban, West Sumatera. Students' environmental literacy data was obtained by an objective test instrument uses indicators from the North American Association for Environment Education (NAAEE). The results of statistical analysis showed that the PjBL model based on TEK has an effect on students' environmental literacy. The average score achieved by students in the class group using PjBL model based on TEK is higher than students who are taught by PjBL model only. By including TEK in the learning process it is an effort to grow and improve student environmental literacy.

Keywords: Traditional Ecological Knowledge; PjBL; Students Environmental Literacy; learning

ABS-ICMSCE-24083

**Preliminary Research For The Development of A
Modern Digital Physics E-Book**

Dewi Hikmah Marisda, Ismail Tolla, Muhammad
Arsyad

Universitas Negeri Makassar

dewihikmah@unismuh.ac.id, ismail.tolla@yahoo.com,
m_arsyad288@unm.ac.id

This research is survey research that examines the problems experienced by prospective physics teacher students in modern physics lectures. Modern Physics is

one of the mandatory courses for physics education students. Therefore, exploring the problems experienced by students when attending lectures is very important to research. The research subjects were 32 physics education study program students at a private university in Indonesia. Data collection was carried out by observing student responses while attending lectures, as well as open and unstructured interviews with course lecturers. The research results obtained were that there were 81.25 % of students tended to memorize physics formulas without understanding the meaning of each formula; 75.00 % of students stated that modern physics teaching materials were not available so students had to look for lecture materials themselves; and 84.38 % of students who stated that it was not easy to access modern physics material via cellphone, had to use a laptop or go to the library. This preliminary research concluded that the physics education study program at one of the private universities in Indonesia does not yet have a special reference book for modern physics lectures. So there is a need for further research in the form of developing textbooks that suit student needs and the demands of the physics education study program curriculum. The planned textbook is in the form of an interactive flipbook.

Keywords: early studies, electronic textbooks, interactive flipbooks, limited teaching materials.

ABS-ICMSCE-24095
**Analysis of Articles Indexed in Scopus Regarding the
Use of Computer Models in Science Learning:
Systematic Literature Network Analysis**

Rahmi Zulva, Agus Setiawan, Andi Suhandi, Achmad
Samsudin

Universitas Pendidikan Indonesia
rahmi.zulva@upi.edu

The aim of this research is to describe research trend data related to learning media. The research method used is the Systematic Literature Network Analysis (SLNA) method. This research data is a research article on computer models in the last 5 years. Articles are collected from the Scopus database consisting of IEEE, Springer and search applications with Publish or Perish (PoP). On the disbursement machine, 535 articles were found from 2019-2024. The results of the title filter obtained 137 articles, and based on the keywords from these articles, 35 articles were obtained that were suitable for analysis. The analysis results show that the number of reviews and citations has decreased every year. Topics that often arise in discussing computer models or learning to use computers are models, modeling, computing, and computational models. The most recent research themes are about computer graphics and computer vision. For further research directions, computer vision can be carried out in earth science learning, to be able to model the earth in computer media or what is called a computer model. Using computer vision, so that learning using computer models can display the process of phenomena occurring

on earth, where the discussion is carried out microscopically.

Keywords: Computer, Computer Model, Systematic Literature Network Analysis

ABS-ICMSCE-24105

Automatic Calibration Equation for Microcontroller Based Dip Coater Tools with Point Capture Calibration System

anton hartanto, Nizar Rizki Rahman, Imam Sya'roni,
Agus Dwi Prasetyono, Irfan Subiantoro

State University of Surabaya

antonhartanto@unesa.ac.id, nizarrahman@unesa.ac.id,

D11212805@mail.ntust.edu.tw,

agusprasetyono@unesa.ac.id,

irfansubiantoro@unesa.ac.id

Microstructure technology is developing very quickly. Nanomaterials are very important, especially in manufacturing thin films made from organic, inorganic, metallic, and non-metallic materials, which can have the properties of conductors, semiconductors, superconductors, or insulators. Much research has been carried out regarding the process of making thin films. Dip-coating involves immersing the material in a solution for a specific time and then removing the material from the container. In the dip-coating technique, several parameters are essential to control. These parameters include immersion speed, soaking time, and material

withdrawal speed from the coating material. Withdrawal speed is an essential variable in this technique because it affects the thickness of the layer formed. Giving different speeds will produce different layer thicknesses. This research will formulate a dip coater calibration system that can digitally regulate the immersion and withdrawal speed to program a microcontroller-based dip coater according to user needs. The method used is Research and Development. The problems that have been presented can be solved using mathematical equations that are often applied in real life. Applying equations in the stepper motor calibration process is a solution to obtain precision and accuracy tools. Through a simple mathematical approach, a dip coater tool calibration equation can be formulated with a point capture calibration system, which can increase the precision and accuracy of the tool and minimize more accurate errors.

Keywords: dip coater, dip-coating, calibration, automatic

ABS-ICMSCE-24110

**Preliminary Research on the Development of
Ethnoscience-Based Science Teaching Modules for
Students at Majene Middle School**

Rezqi Sri Saleko Putri, Jasruddin, Mustafa

Universitas Negeri Makassar

rezqisrisalekoputri@gmail.com, Jasruddin@unm.ac.id,

mustafa@unm.ac.id

This study is a survey research that examines the problems faced by students in learning natural sciences (Science), integrating the learning process between local culture and the scientific knowledge they possess. Science is a form of knowledge, thus its scope is limited only to the empirical world, which encompasses things within human experience. Science is not merely theoretical; it emphasizes a process where concepts must be discovered and connected with personal experiences, enabling their application in daily life. Daily life is closely linked to the local culture or wisdom of the students, thus creating a teaching module or device based on local culture or wisdom that is relevant to their daily lives can have a positive impact on enhancing students' interest in science. Therefore, investigating the problems students face during the learning process is crucial. The subjects of this study were 28 students from Majene Regency in West Sulawesi Province, Indonesia. Data collection was conducted through observation of the students' responses during lessons and through open, unstructured interviews with educators. The findings indicate that 81.25% of students tend to understand science material without recognizing its connection to or application within local culture; 75% of students reported that the available science teaching modules or learning devices are too general, leading to boredom and monotony in the learning process. This preliminary research concludes that a middle school in Majene, Sulawesi, requires a teaching module or device that integrates local wisdom with the scientific knowledge possessed by the students, necessitating further research for the development of a suitable teaching module tailored to the students' needs.

Keywords: initial studies, science, ethnoscience-based teaching modules, ethnoscience

ABS-ICMSCE-24112

**Integrating Physics and Sustainable Technology in
Pharmaceutical Education: A Socio-Technical
Approach**

Meiry Akmara Dhina, Ida Kaniawati, Ade Gafar
Abdullah, Lilik Hasanah

Universitas Pendidikan Indonesia

meiryakmaradhina@gmail.com, kaniawati@upi.edu,
ade_gaffar@upi.edu, lilikhasanah@upi.edu

This research explores the role of physics in the development of sustainable technologies in pharmacy through the teaching of pharmaceutical physics. This educational approach is built upon a socio-technical system framework that promotes the collaboration of social and technological values. Pharmacy, as a health science closely intertwined with social and technological elements, demands the integration of both to enhance its effectiveness. Physics serves as a fundamental science crucial in the development of technologies in the pharmaceutical field, thus requiring an in-depth examination of its role in pharmacy. The research methodology involves an analysis of relevant scientific literature, case studies of recent technological advancements in the pharmaceutical industry, as well as an evaluation of the curriculum and teaching methods used in the Pharmaceutical Physics course. The findings

of this study demonstrate the multitude of physics concepts that can contribute to improving pharmaceutical quality, especially in the field of pharmaceutical technology. Consequently, a concept map illustrating the interconnection between physics and pharmacy is developed, leading to the creation of a Semester Learning Plan (RPS) based on physics and sustainable technology in the pharmaceutical physics course. Furthermore, the research discusses the importance of integrating physics concepts into the pharmacy curriculum to provide students with a comprehensive understanding of the role and application of physics in the sustainable pharmaceutical industry.

Keywords: Physics; Sustainable technology; Socio-technical system; Interdisciplinary learning; Pharmaceutical

ABS-ICMSCE-24118

**Utilization of Thermodynamic Heat Capacity in Life:
Systematic Literature Review**

Ana Rahmawati, Ida Hamidah, Achmad Samsudin,

Diana Rochintaniawati

Universitas Pendidikan Indonesia

anasilfiani22@upi.edu, idahamidah@upi.edu,

achmadsamsudin@upi.edu,

diana_rochintaniawati@upi.edu

Heat capacity is an important concept in physics and engineering, measuring the amount of heat required to

increase the temperature of a particular material. This research uses the Systematic Literature Review (SLR) method which aims to identify the use of heat capacity in life. From the Scopus data collected, there were 53,636 articles obtained based on the keyword "heat capacity", but after analysis, 19 articles were in accordance with the literature to be reviewed. In this article, we will discuss the meaning of heat capacity, how it differs from specific heat, and how it is applied in thermal systems. Also covers concepts such as volumetric and mass heat capacity, and the differences between solid, liquid, and gaseous materials and discusses how heat capacity can be measured and factors that influence heat capacity such as temperature, pressure, and material composition. From the results of the Systematic Literature Review (SLR), it was concluded that the concept of heat capacity is very important in various applications in daily life, and has a key role in various applications, for example in the design of heating equipment, cooling systems, and thermodynamic modeling. Heat capacity applications are used in various industries, for example the food industry, medicine, machinery, and so on. For the heat capacity delivery materials used, they consist of solid, liquid and gas materials.

Keywords: Heat capacity, Thermal system, Thermodynamics

ABS-ICMSCE-24120
**Computational Thinking Profile In Solving Problem
Of Babras Challenge Task on Coding Training
Student**

Riskawati Riskawati
Universitas Pendidikan Indonesia
riskawati@unm.ac.id

In some countries, students learn to code from an early age. Coding is one of the necessary 21st century skills. Learning to code has an effect on students' computational thinking ability. Computational thinking is a student's ability to solve problems through decomposition skills, pattern recognition, algorithmic thinking, and abstraction and generalization of patterns to get a solution. This study aims to describe the computational thinking ability of students who attend coding training in completing free tasks. This research is a qualitative descriptive study. The subjects in this study consisted of 2 students who had high CT abilities, 2 students who had moderate CT abilities, and 2 students who had low CT abilities. The data collection technique used a written test (free task) and interviews, then the data was analyzed based on the indicators of students' computational thinking. The results of this study indicate that students who have high CT abilities in completing free tasks are decomposition, pattern recognition, algorithm thinking, as well as generalization and abstraction of patterns, students with moderate CT abilities only on indicators of decomposition, pattern recognition, and algorithmic thinking, while students with moderate CT abilities only use indicators of decomposition, pattern recognition, and

algorithm thinking. with low CT ability in completing free tasks only on decomposition indicators and thinking algorithms.

Keywords: learning to code, computational thinking, Bebras of task.

ABS-ICMSCE-24129

Implementation of test instruments to measure students' critical thinking skills on sound wave

Faizatul Mabruroh, Andi Suhandi

UIN Raden Fatah Palembang

faizatul.mabruroh_uin@radenfatah.ac.id,

This research aims to determine the implementation of test instruments that measure students' critical thinking skills on sound wave subject. The test instrument which is used in form of essay questions consisting of 12 questions containing 4 indicators and 9 sub-indicators of critical thinking skills proposed by Ennis. The instrument used has been declared valid and reliable so that it can be used for implementation testing. The results of the hypothesis test with a difference of 2 average values show that the instrument used can differentiate between learning processes that train and do not train critical thinking skills, where the z-count value of 10.17 is greater than the z-value of 0.05 so it can be concluded that the research hypothesis is accepted. To measure the identification of similarities in learning models that train critical thinking skills using the results of the one-way Anova test, where

the significance value of 0.35 is greater than 0.05, so it can be concluded that the research hypothesis is accepted. Next, to assess the relationship between critical thinking skills and understanding of teaching material, use the Pearson Product Moment correlation test, where the degree of closeness of the relationship between critical thinking skills and understanding of teaching material is shown by the correlation coefficient value, namely 0.51. This means that the degree of relationship between critical thinking skills and understanding of teaching material is included in the high criteria.

Keywords: test instrument, critical thinking skills, sound wave.

ABS-ICMSCE-24137

Using System Thinking Skill in Research Biology for Sustainable Development Goals: A Systematic Review

Lathifah Radha Istiyova

Universitas Sebelas Maret

radhaistiyova07@student.uns.ac.id

System thinking is the ability to understand complex systems which is very important in biological education because it demonstrates biological reasoning. This ability is one of the main competencies to realize sustainable development. The main objective of this review is to investigate research findings on the use of systems thinking in biological research that supports sustainable

development. This research uses a systematic analysis and synthesis approach to 31 articles from 2019 to 2024 including peer-reviewed articles and full article texts from Scopus and Google Scholar. The results showed that systems thinking is used to understand certain biological research in a connected system. Consider environmental problems that focus on interactions in ecology. To understand the relationship between these elements that can solve environmental problems for the realization of sustainable development.

Keywords: system thinking, research biology, sustainable development.

ABS-ICMSCE-24138

Exploring the Implementation of Artificial Intelligence in the Perspective of Teachers and Students

Fanny Rahmatina Rahim
Universitas Pendidikan Indonesia
fannyrahmatina@fmipa.unp.ac.id

Background: The growing interest in the integration of Artificial Intelligence (AI) in education has prompted a comprehensive investigation into the perspectives of both teachers and students. This study aims to provide insights into the implementation and impact of AI in education based on a systematic literature review. **Purpose:** The primary objective of this systematic literature review is to explore and analyze the perspectives

of teachers and students regarding the implementation of AI in education. By focusing on articles published between 2020 and 2023 from the Scopus database, the study aims to uncover key insights into the benefits and challenges associated with AI integration in educational settings. Methods: A total of 50 articles retrieved from the Scopus database, using the keywords "Artificial Intelligence" and "Education," were systematically analyzed. The analysis, facilitated by Publish or Perish software, concentrated on two main themes: the implementation and impact of AI on teachers and students. The selected timeframe, from 2020 to 2023, ensures a contemporary examination of the subject. Results: The findings of the systematic literature review indicate significant benefits associated with the implementation of AI in education. For teachers, AI facilitates personalized task assignments, human-machine conversations, and offers valuable feedback through student work analysis. Additionally, it enables the tracking of learning progression for customized content delivery. Students, on the other hand, benefit from personalized feedback, adaptive content, and the promotion of reasoning, physical development, and basic AI understanding. The integration of AI concepts into curricula is identified as a key factor in preparing students for the digital age, providing personalized and adaptive content while enhancing motivation and engagement. Conclusion: The findings underscore the importance of integrating AI concepts into educational curricula to prepare students for the evolving digital landscape. Future research endeavors should prioritize practical AI

implementation and assess its long-term effects on learning outcomes.

Keywords: Artificial Intelligence, AI in education, Personalized learning, Systematic literature review

ABS-ICMSCE-24139

Development of Baseball Hitter Simulation Using Scratch Program to Enhance Generic Science Skills on Impulse and Momentum Concept

Muhamad Taufiq, Ida Kaniawati, Liliyasi, Achmad Samsudin

Universitas Pendidikan Indonesia

muhamadtaufiq@upi.edu, kaniawati@upi.edu,

liliyasi@upi.edu, achmadsamsudin@upi.edu

Corresponding Authors: kaniawati@upi.edu,

muhamadtaufiq@mail.unnes.ac.id

One phenomenon that illustrates the concepts of impulse and momentum is the act of hitting a ball in the sport of baseball. Explaining the concepts of impulse and momentum is not easy to bring directly into the classroom for analysis, hence a simulation program based on computer technology using the Scratch application needs to be designed. This study aims to develop a baseball hitter simulation using Scratch programming to enhance students' generic science skills in the concepts of impulse and momentum. Research and Development (R&D) was carried out using the ADDIE method (Analysis, Design,

Development, Implementation, and Evaluation). The research instruments are feasibility validation questionnaire and generic science skills test. The data analysis technique used in the study are percentage and N-gain score. The research results in the form of a baseball hitter simulation program using Scratch have been tested for feasibility. The product's feasibility was analysed based on the average percentage score of content expert validation at 98.4%, media and technology expert validation at 90.8%, and enhancement in students' generic science skills. The product trial used one-group pre-test and post-test design. The product in this research is in the form of ICT-based impulse and momentum teaching materials. Programming applications in teaching materials are in the form of Scratch with a contextual learning approach, namely baseball hitter simulation using scratch program that are closely related to life. The average percentage validity of teaching materials in terms of content is very decent category. The effectiveness of teaching materials is seen from the increase in generic science skills in the end of learning activity. Finally, conclusion can be state that the developed of baseball hitter simulation using Scratch programming is feasible and effective to enhance students' comprehension on impulse and momentum concepts. The most significant contribution of this research is the development of a highly effective and feasible Scratch-based baseball simulation that significantly enhances students' understanding and application of the concepts of impulse and momentum. To further enrich science education, educators should consider developing a series of interactive, sports-themed simulations using Scratch to

teach various physics concepts, making learning both fun and contextually relevant for students.

Keywords: Baseball hitter simulation, Scratch programming, Impulse and momentum, Generic science skills

ABS-ICMSCE-24141

**Problem Solving based learning for Complex
Problem Solving learning models in Science
Education: a case study in college**

Sohibun Sohibun, Kurniawan, A, Samsudin, A, Suhandi,
A

Universitas Pendidikan Indonesia
sohibbie.165@upi.edu

This case study investigates the strategies and approaches employed by individuals in solving complex problems in science education especially in physics course. The study focuses on the cognitive processes involved in problem-solving, particularly in situations where the problem is multifaceted and requires a deep understanding of the underlying issues. The research aims to identify the most effective methods and techniques used by individuals to tackle complex problems, and to explore the role of cognitive biases and heuristics in the problem-solving process. The study employed a qualitative approach, using semi-structured interviews and observations to gather data from a sample of 20 participants who were presented with a complex problem scenario. The findings

indicate that participants did not using employed a range of strategies, including breaking down the problem into smaller components, seeking additional information, and using analogies and metaphors to facilitate understanding. Additionally, the study found that cognitive biases and heuristics played a significant role in the problem-solving process, often influencing the decisions made by participants. The study's results have implications for the development of effective problem-solving strategies and the design of training programs aimed at improving complex problem-solving skills. The findings suggest that individuals should be encouraged to adopt a systematic and structured approach to problem-solving, and that training programs should focus on developing critical thinking and analytical skills. The study's results also highlight the importance of considering the role of cognitive biases and heuristics in the problem-solving process, and the need for individuals to be aware of these biases in order to make more informed decisions. the conclusion PBL for CPS better be focused for how using rich context in the problems then make it difficult in math problem solving only.

Keywords: Problem based learning, complex problem solving, science education

ABS-ICMSCE-24148

IGE: A Learning model that Integrated Guided Inquiry and Educational Games to Enhance Science Process Skills in Elementary Schools

Muspratiwi Pertiwi MR, Patta Bundu, M. Yahya
Universitas Negeri Makassar
muspratiwibill10@gmail.com

A preliminary study showed that the learning process in elementary schools could not encourage students' science process skills. The aims of this study are (1) to develop a guided inquiry learning model based on educational games, and (2) to determine the validity, practicality, and effectiveness of the IGE model in science learning. This type of research is Research and Development (R & D). The learning model was developed using a development procedure adapted to the Plomp model, which consists of the following stages: a) Phase-1: preliminary investigation, b) Phase 2: design, c) Phase 3: realization, d) Phase 4: testing, evaluation, and revision, and e) Phase 5: implementation. The population of this study is all upper-grade elementary school students in Pinrang Regency, South Sulawesi. This study involved 80 students in the even semester of 2023/2024 at UPT SDN 99, UPT SDN 101, and UPT SDN 214 Pinrang. The research instruments used in this study are validation sheets for the learning model and learning devices, observation sheets for the implementation of the syntax and responses for the practicality of the learning model, and science process skills tests. The results of this study include: (1) a new learning model, namely IGE, which consists of four learning stages (Activation, Playing,

Exploration, Wrap-up); (2) The validity of the IGE model is very high with an average score of 3.55. The IGE learning model is considered very practical in improving students' science process skills, received positive responses, and is quite effective in improving students' science process skills. Therefore, it can be concluded that the IGE model has met the requirements as a valid, practical, and effective learning model to improve students' science process skills.

Keywords: Science process skills, guided inquiry, educational games, science, elementary school.

ABS-ICMSCE-24154
**ETHNOMATHEMATICS PROBLEM-BASED
LEARNING IN IMPROVING MATHEMATICAL
PROBLEM-SOLVING SKILLS OF ELEMENTARY
SCHOOL STUDENTS: A SYSTEMATIC REVIEW
OF 2020 TO 2024**

Novi Yarmanetti, Sujarwo, Herwin, Haryanto, Fery
Muhamad Firdaus, Yoppy Wahyu Purnomo
Yogyakarta State University
noviyarmanetti.2023@student.uny.ac.id,
sujarwo@uny.ac.id, herwin89@uny.ac.id,
haryanto_tp@uny.ac.id, fery.firdaus@uny.ac.id,
yoppy.wahyu@uny.ac.id

Mathematical problem-solving skills are very important for students, especially students in elementary school in

understanding mathematics material, but the reality of problem-solving skills among elementary school students is still concerning, due to the lack of understanding of mathematical concepts and the lack of problem-solving exercises by teachers in the classroom. From various studies conducted previously, problem-based learning is still not able to improve problem-solving skills in students. For this reason, it is necessary to modify PBL with an ethnomathematical approach to make it easier for students to solve mathematical problems. This study aims to explain how problem-based learning with ethnomathematical nuances can improve students' mathematical problem-solving skills in elementary school. This study uses the Harzing's Publish or Perish application and uses the keywords Problem based learning, ethnomathematics, problem-solving skills from the Scopus and Google Scholar databases published between 2020 and 2024 there are 26 articles. Then the 26 articles were filtered based on inclusion and exclusion so that 8 articles were obtained that were worthy of review. The results of the study of the 8 articles are (1) Research related to PBL Ethnomathematics has received quite good attention as seen by several articles that discuss this, (2) students in the fifth grade of elementary school are often used as research samples, (3) many researchers in the development of PBL Ethnomathematics mostly study culture from Java, but some from Aceh and NTT, so there is still an opportunity to explore PBL Ethnomathematics developers by studying culture from the region other.

Keywords: Problem based learning, ethnomathematics, problem-solving skills

ABS-ICMSCE-24170

**Systematic Review of Test Instrument for Measuring
Scientific Reasoning in the Last Decade**

Aghnia Nadhira Afa, Taufik Ramlan Ramalis, Ridwan
Efendi
UPI

aghnianadhira@upi.edu, taufik_lab.ipba@upi.edu,
ridwanefendi@upiedu

The primary aim of this research was to conduct a systematic review on the instrument test of scientific reasoning in science. The employed research method involved a thorough exploration of diverse databases through Scopus, employing the keywords "scientific reasoning", "test", "assess*", "measure*", "scale*", "identify*", "analysis*" to retrieve pertinent articles. A total of 30 articles were selected as research samples and subjected to analysis. This research revealed that the target group was classified into four groups: elementary school student (25.00%), junior high school student (16.67%), senior high school student (8.33%), and university student (50%). In addition, the scientific reasoning test formats used are essay (E), experiment task (EX), double choice (DC), multiple choice (MC), mixed question format (MQ), oral (O), questionnaire (Q), and self-assessment (SA). The test instruments used in each literature are very diverse. Instruments that were used

more than once are LCTSR, Science-K Inventory, Ko-WADiS, and QuASSR. The context of these instruments consists of biology (B), chemistry (C), engineering (E), medicine (M), natural science (NS), physics (P), science (S), and social science (SS). The instruments have psychometric properties of one or a combination of validity (V), reliability (R), discrimination (D), item difficulties (ID), and distractors (DI).

Keywords: Instrument, Scientific Reasoning, Systematic Literature Review

ABS-ICMSCE-24174

**Analysis of the need for using Geospatial Technology
in developing student worksheets**

Ziyad Fadhlannabil

Universitas Pendidikan Indonesia

ziyadfadhlannabil@upi.edu

This research aims to determine the need for developing student worksheets based on Geospatial Technology as a student learning resource in physics subjects in high school. This research uses mixed methods, consisting of qualitative data and quantitative data. This research involved 23 respondents spread across several schools in Padang, West Sumatra. The instrument in this research used a needs questionnaire with 15 questions, namely 7 questions to identify difficulties in solving physics problems, 6 questions to use student worksheets. Based on the needs questionnaire, it is known that 57.1% of

respondents really need it and 52.4% really hope for the development of geospatial technology in physics learning as a student worksheet. The results of the needs questionnaire analysis show that student worksheets developed with Geospatial Technology, especially on the topic of renewable energy sources, are needed and are expected to be able to help students achieve the desired learning goals. Based on this, the use of technology as a learning resource is really needed by students, so it is necessary to carry out a needs analysis in developing student worksheets based on Geospatial Technology.

Keywords: Student worksheets, geospatial technology, learning resource

ABS-ICMSCE-24177
**THE RASCH MODEL ANALYSIS IN
DEVELOPING INSTRUMENT TEST TO
MEASURE CREATIVE THINKING SKILLS ON
STATIC FLUIDS**

Nisa Alyaumusyifa, Irma Rahma Suwarma, Ida
Kaniawati

Universitas Pendidikan Indonesia
nisaalyaumusyifa@upi.edu, irma.rs@upi.edu,
kaniawati@upi.edu

Research and development for instrument test to measure Creative Thinking Skills (CTS) based on the lack of continuous test tools that measure it, especially static fluid phenomenon in everyday life. The test that is developed

based on Torrance Test of Creative Thinking (1966) that can measure four aspects of Creative Thinking Skills (fluency, flexibility, originality and elaboration). The Bloom's Taxonomy of cognitive dimension who revised by Anderson-Krathwohl told that Creative Thinking Skills are the same as cognitive dimension level C6 (create). Mixed Methode with Sequential Exploratory Approach used in this research, the results are analyze by Aiken V and Rasch Model. After the judges reviewed and validate the Static Fluids CTS Instrument Test, Aiken V used to knowing the instrument test is valid theoretically. Rasch model used to knowing the characteristics of test, item and person, also validity empirically, reliability, difficulties index (b) and discrimination index (a) are analyze. Amount of 218 students participated, the students from the ones of regular senior high school and indepent school in Bandung, Indonesia. Winstep 5.4.2.0 is ones of many applications based on Rasch Model that integrated to Ms. Excel. Rasch Model Analysis claimed that are 20 items of Fluids Statics CTS Test is valid empirically. Reliability observed by "TEST" RELIABILITY 0,79 (good category), Item RELIABILITY 0,98 (special category) and Person RELIABLITY 0,77 (enough consistency category). Dificulties index (b) observed by JMLE MEASURE 0,00 (medium category) and discrimination index (a) observed by ITEM SEPARATION 7,47 (very high category).

Keywords: Creative Thinking Skills, Developing Instrumen test, Rasch Model Analysis

ABS-ICMSCE-24180

**Curriculum in the Eyes of Future Educators: A
Metaphor Analysis from First Year Pre-service
Science Teachers**

Charlos Falentino, Evanita Mutang, Abdul Hakim, Nurul
Fitriyah Sulaeman, Atin Nuryadin
Universitas Mulawarman

charlofalentino@gmail.com, evanitamtg@gmail.com,
abdul.hakim@fkip.unmul.ac.id,
nurul.fitriyah@fkip.unmul.ac.id,
atin.nuryadin@fkip.unmul.ac.id

First-year science pre-service teachers are a vital future generation dealing with various education systems, not least of which is the curriculum. This study aims to understand how first-year science pre-service teachers perceive the curriculum. This study was conducted using a questionnaire administered to 104 respondents of first-year science pre-service teachers, and then metaphor-based analysis for data analysis. This study's results show that most first-year science pre-service teachers have positive expectations and are optimistic about the curriculum. These results indicate a sound belief of first-year science pre-service teachers who will pursue the world of education. Compared to past research on teachers, it was found that few teachers consider the curriculum a problem. This may be because first-year science pre-service teachers have not experienced first-hand how the curriculum works. This study is expected to contribute in-depth information about the influence of the curriculum on the perceptions of first-year science pre-service teachers, compared with previous research related

to the perceptions of teachers who have entered the workforce

Keywords: Curriculum, Metaphor, Pre-service Science Teachers, First Year

ABS-ICMSCE-24187

Enhancing E-Waste Management in Indonesia: A Study of Knowledge Levels Among TVET Electrical Engineering Students and Current Practices

ALBERT ADJEI

Universitas Pendidikan Indonesia (UPI)

albertadjei748@gmail.com

Electronic waste (e-waste) is the world's fastest-growing waste stream, posing environmental and health threats. This study highlights the urgency of improved e-waste management in Indonesia, a major e-waste producer with inadequate infrastructure. The research focuses on tech-savvy electrical engineering students in vocational training programs to assess their knowledge and current e-waste practices. By empowering youths, the study seeks to develop solutions for sustainable e-waste management in Indonesia, contributing to global environmental health and economic development

Keywords: E-waste (electronic waste), Youths, Technical and Vocational Education and Training, Engineering

ABS-ICMSCE-24188
**LEARNING MODEL CYCLE 7E WITH WRITING
IN THE DISCIPLINE STRATEGY TO IMPROVE
COGNITIVE ABILITY AND SCIENTIFIC
EXPLANATION SKILLS ON STATIC FLUID
CONCEPTS**

Maryam Musfiroh, Taufik Ramlan Ramalis, Ridwan
Efendi
UPI
maryammusfiroh@upi.edu, taufik_lab.ipba@upi.edu,
ridwanefendi@upi.edu

The purpose of this study was to determine the analysis of increasing cognitive abilities and scientific explanation skills of high school students through implementing the 7e learning cycle model with the writing in the discipline strategy on static fluid material. The method used in this study is mixed methods with an experimental mix methods design type of research. The population in this study were class XI MIPA students at one of the state senior high schools in Garut, West Java. The population and sample in this study were 147 students who were divided into 2 groups, namely the experimental group and the control group. Data analysis uses N-Gain to determine the increase in students' cognitive abilities and scientific explanation skills regarding the application of the 7e learning cycle model with the writing in the discipline strategy. The results of data analysis show that the application of the 7e learning cycle model with the writing in the discipline strategy has a positive influence on increasing the cognitive abilities and scientific

explanation skills of high school students in static fluid material.

Keywords: learning Cycle 7e, Writing Strategy, Cognitive Ability, Scientific Explanation skills

ABS-ICMSCE-24189

**The Effect of Model-Based Learning assisted by
Augmented Reality on Cognitive Process Skills on
The Topic of Heat Transfer**

Widia Linta Nurjanah, Dr. Ika Mustika Sari, M.PFis, Dr.
Duden Saepuzaman, S.Pd, M.Pd, M.Si
Universitas Pendidikan Indonesia
widialinta@upi.edu, ikams@upi.edu,
dsaepuzaman@upi.edu

Model-based learning is developed using three principles from Johnson Laird: Learning from models, learning about models and learning with models. Model-based learning is combined with Augmented Reality learning media. The purpose of this study was to determine the effect of Augmented Reality-assisted model-based learning on cognitive process skills. The research method used is quantitative with a control pretest and posttest design research design. Participants who followed this study were divided into two classes, namely the experimental class and the control class, the experimental class of 26 students and the control class of 25 students. Pretest and posttest data were analyzed by hypothesis testing and effect size calculation. The results show that

Model-based Learning assisted by Augmented Reality affects the cognitive process ability of students, it is shown from the hypothesis test value sig < 0.05 so that H_a is accepted. The acquisition of the experimental class n-gain value of 0.465 with a medium category while the control class obtained an n-gain value of 0.27 with a low category. Then reinforced by the effect size value, which is actually 1.62 with a high category, so it can be concluded that Model-based Learning assisted by Augmented Reality has a high influence on the cognitive process ability of students.

Keywords: Model based Learning, Augmented Reality, Cognitive Process Skill, Heat Transfer

ABS-ICMSCE-24192

Immersive learning in quantum physics: Designing and validating a virtual reality prototype for photoelectric effect experiments

Hartono Bancong

Universitas Muhammadiyah Makassar

hartono.b.b@unismuh.ac.id

The photoelectric effect is one of the crucial experiments that significantly contributed to the advent of quantum physics. However, the limited availability of experimental equipment presents a significant challenge for educational institutions, including Universitas Muhammadiyah Makassar. To address this issue, this study aims to develop a virtual reality prototype that can be used for

conducting photoelectric effect experiments in laboratory settings. This study employs research and development methodology. The development process included iterative design and testing phases in order to incorporate feedback from experts and practitioners. Three validators, including two content experts and one practitioner, assessed the validity of the system. The validation focused on the simulation's accuracy, user interface, educational value, and overall usability in a classroom setting. The results indicate that the prototype of virtual reality for the photoelectric effect experiment is effective and suitable for educational use. The validators confirmed that the prototype accurately simulates the photoelectric effect and can provide an engaging and interactive learning experience. This virtual reality-based photoelectric effect experimental model has great potential to increase students' understanding of quantum physics concepts through immersive simulations. This research concludes that this virtual reality-based experimental prototype offers a promising solution to the challenges faced by educational institutions in conducting photoelectric effect experiments. This innovative approach not only overcomes equipment limitations but also offers a sophisticated educational tool suitable for integration into the physics curriculum.

Keywords: virtual reality, quantum physics, photoelectric effect, immersive learning

ABS-ICMSCE-24197
**Motivation learning in Physics Education Research
on the Scopus Database over two Decades:
Bibliometric Analysis**
Nur Aini, Dadi Rusdiana
Universitas Pendidikan Indonesia
rhamidnuraini@gmail.com, dadi_rusdiana@upi.edu

This study conducts a bibliometric analysis of research on motivation learning within the field of physics education over two decade (2004-2024). The main findings of this article describe motivation learning within the field of physics education research in terms of scientific production, preferred publication sites, majority of researchers and research countries (including collaborations), and research themes. The total of 540 articles obtained indexed by Scopus database were analyzed using a Bibliometric variable perspective and using the VOSviewer package program which will be presented in visual and tabular form. The research results show the highest publication growth occurred in 2022, reaching 104 articles (19.26%), while the lowest publication occurred in 2013, which only amounted to 4 articles (0.74%). The most international publications were published by the Journal of Education Sciences with 26 articles, while the most productive motivation learning within the field of physics education research authors were Ladachart L & Phothong W. This analysis also shows that the United States has the largest contribution to motivation learning within the field of physics education research in the field of education. Collaboration among monitored researchers is still formed locally, not

yet expanding to inter-country. Trending topics and hotspots in motivation learning within the field of physics education in Education research relate to the influence and skills produced by motivation learning within the field of physics education in learning. And finally, this article can provide useful information for empirical researchers to find out new research and research gaps for further research so that it does not overlap with existing research.

Keywords: Bibliometrics, Motivation Learning, Physics

ABS-ICMSCE-24203

Physics education student's interpretation of drawings depicting dye-sensitized solar cell as STEM-ESD activities created by Generative AI

Arip Nurahman

Universitas Pendidikan Indonesia

nebulaarip99@gmail.com

This study examines how physics education students interpret AI-generated drawings of dye-sensitized solar cells (DSSCs) within the context of STEM and Education for Sustainable Development (ESD) activities. Conducted with 24 students from the physics education program at IPI Garut, the research aims to evaluate the effectiveness of these AI-generated visuals in facilitating the understanding of complex scientific concepts and their relevance to sustainability. Through qualitative analysis, the study investigates the students' responses to the AI-generated drawings, focusing on their comprehension,

engagement, and the educational benefits of incorporating AI into STEM-ESD curricula. The findings suggest that AI-generated drawings significantly enhance the visualization and understanding of DSSCs, thus supporting educational strategies that promote scientific literacy and sustainability awareness.

Keywords: Physics education, Dye-sensitized solar cells (DSSCs), STEM-ESD, Generative Artificial Intelligence

ABS-ICMSCE-24208

**MAPPING OF HIGH SCHOOL PHYSICS
SCIENCE LITERACY ANALYZED USING
INSTRUMENTS BASED ON LOCAL WISDOM
AND PANCASILA STUDENT PROFILE**

DEWI DEWANTARA, ISMI FAJARIAH,
ZAINUDDIN, MUSTIKA WATI, SRI HARTINI

Physics Education Study Program, Universitas Lambung
Mangkurat

dewantara_pfis@ulm.ac.id, dewantara_pfis@ulm.ac.id,
zainuddin_pfis@ulm.ac.id, mustika_pfis@ulm.ac.id,
srihartini_pfis@ulm.ac.id

The scientific literacy abilities of students in Banjarmasin City and Barito Kuala Regency have not been mapped. Therefore, this research aims to map physics science literacy skills using instruments based on local wisdom and the Pancasila student profile of high school level students in Banjarmasin City and Barito Kuala Regency. This research includes quantitative research using

purposive sampling techniques. The research subjects were students at State High School level in Banjarmasin City and Barito Kuala Regency with a sample of three schools each. This research used a sample of 6 schools with a total of 207 students. Data was obtained through surveys and data collection was carried out using test instrument sheets. The data was analyzed descriptively with data analysis techniques using the Rasch model in the Winstep application. The results of the research show that the scientific literacy abilities of high school students in Banjarmasin City and Barito Kuala Regency are in the sufficient category and the quality of the questions and the reliability aspects of the instruments are good. This sufficient category of scientific literacy ability is caused by low interest in reading, lack of students' analytical skills, teachers' lack of knowledge about scientific literacy, and evaluation tools that do not yet lead to scientific development. So it can be concluded that the high school physics science literacy profile in Banjarmasin City and Barito Kuala Regency is in the sufficient category.

Keywords: Scientific Literacy, Mapping, senior high school, local wisdom, pancasila student profile, physics

ABS-ICMSCE-24212

Bridging Perspectives: A Comparative Analysis of Sustainable Development Goals (SDGs) Knowledge and Practice Among Junior High School Students in Indonesia and the Philippines

Dian Pasaribu, Nurul Fitriyah Sulaeman, Ph.D., Kenan
Jairus C. Quitco, M.Ed.
Mulawarman University
dianrachelsrb@gmail.com

This study investigates the knowledge and practice of Sustainable Development Goals (SDGs) among junior high school students in Indonesia and the Philippines. Employing a comparative analysis approach, the research aims to identify the similarities and differences in understanding and implementing SDGs in the two countries. Data were collected through Google form, focusing on awareness, attitudes, and activities related to SDGs. Results reveal that students in both countries exhibit a high level of awareness of SDGs, particularly in areas related to climate action, quality education, and reduced inequalities. However, significant differences were noted in the practical application of this knowledge. Indonesian students showed a stronger inclination towards community-based projects and environmental initiatives, while Filipino students were more engaged in school-led activities and digital advocacy campaigns. This findings provide valuable insights for policymakers, educators, and stakeholders aiming to foster a deeper and more actionable understanding of SDGs among young learners in Southeast Asia.

Keywords: SDGs, Knowledge, Practice, Students, Indonesia, Philippines

ABS-ICMSCE-24214

**Analysis of the Use of Virtual Reality Media for
Science Subjects: A Literature Study**

Muh Alka

Universitas Muhammadiyah Makassar
alka@unismuh.ac.id

Virtual reality technology presents exciting new opportunities in the world of education, especially in learning science in secondary schools. This research aims to analyze the use of virtual reality media in science learning in secondary schools based on literature studies. The method used in this research is a literature study by reviewing scientific articles, research journals, and other publications relevant to the research topic. The data collected was analyzed qualitatively using the content analysis method. The results showed that virtual reality media has great potential to improve the quality of science learning in secondary schools. Virtual reality media can help students to better understand abstract and complex concepts in science in a more immersive and interactive way. Virtual reality media can also help students to develop critical thinking, problem solving, and collaboration skills. However, there are some challenges in using virtual reality media in science learning, such as limited availability of virtual reality devices, high cost, and lack of quality virtual reality learning resources. This

study recommends several steps to improve the use of virtual reality media in science learning in secondary schools, such as increase the availability of virtual reality devices in schools. Developing quality virtual reality learning resources. Training teachers in using virtual reality media in learning. Building cooperation between schools, industry, and government to support the use of virtual reality media in learning.

Keywords: literature study, virtual reality, science education

ABS-ICMSCE-24221

Modification of the Self-Assessment to Measure Habits of Mind of High School Students in Physics Learning in Indonesia

Raldy Aditya, Endi Suhendi, Lina Aviyanti
Universitas Pendidikan Indonesia
raldy616@gmail.com, endis@upi.edu,

This study aims to develop an instrument that measures students' habits of mind in physics learning to test its validity and reliability. This instrument was a result of a modification from the self-assessment for measure habits of mind. This research novelty is making a new instrument that solves the shortcomings in self-assessment for habits of mind. So, this instrument can be used by teachers and researchers in Indonesia. The target of this self-assessment will be high school students in Indonesia. Using the ADDIE research model, the self-

assessment for habits of mind was successfully developed and tested on 136 high school students. The results of the CVR analysis and the Rasch model provide an understanding that the self-assessment has good content and construct validity. So, the self-assessment can be stated to have the ability to measure students' habits of mind in physics learning. In addition, the results of the Rasch model analysis provide an understanding that the self-assessment for habits of mind has a moderate person reliability, excellent item reliability, and good internal consistency. Therefore, the self-assessment can be stated to have sufficient consistency in measuring students' habits of mind in physics learning. Thus, the development of an instrument to measure students' habits of mind in physics learning has been done successfully. Hopefully, this research can contribute to Indonesian education, especially to physics teachers and physics education researchers.

Keywords: Habbits of Mind, ADDIE, self-assessment

ABS-ICMSCE-24222

**Requirement Analysis of Assessment Instrument
based Real Picture Analysis (RPA) at Senior High
School Students**

Inas Aulia Majid, Sutarto, Indrawati, Bea Hana Siswati,
Iwan Wicaksono

Universitas Jember

inas.aulia2.official@gmail.com, sutarto.fkip@unej.ac.id,
indrawatisutarto@gmail.com, beahana.fkip@unej.ac.id,
iwanwicaksono.fkip@unej.ac.id

Assessments are important to measure student achievement levels. Assessments represented through pictures can help students' understanding. Through the 2023 PISA test, which was participated in by 81 countries, the average score of students in Indonesia was lower than the average international score. In scientific literacy, the international average score reached 476 while Indonesian students only scored 383. The aim of this research is to determine the analysis of the need for Real Picture Analysis-based assessment instruments to measure scientific literacy in Physics learning for Grade X High School. The type of research used is descriptive qualitative. Data collection uses interview techniques and documentation studies to determine the implementation of assessments used by teachers and students. The research results show that teachers have never specifically measured students' scientific literacy and used image-based assessment instruments. Assessment instruments for measuring student learning outcomes that teachers apply to cognitive aspects come from various books or collections of exam questions. The formative assessment

is in the form of a description, while the summative assessment is in the form of multiple choices. So, teachers hope that there will be an assessment instrument based on Real Picture Analysis (RPA) to measure students' scientific literacy.

Keywords: Instrument Assessment, Real Picture Analysis (RPA), Scientific Literacy

ABS-ICMSCE-24224

Evaluation of Shear Wave Velocity At Rammang-Rammang Maros Karst Area Tn Babul Using Microtremor Data

Sitti Hasaniyah, Sitti Hasaniyah, Agus Susanto
Earth Physics Laboratory, Departement of Physics,
Faculty Mathematics and Natural Science, Universitas
Negeri Makassar, Kampus UNM Parangtambung Jl.
Daeng Tata Raya Makassar 90224, Indonesia
m_arsyad288@unm.ac.id, sittihasaniyah14@gmail.com,
agus.susanto@unm.ac.id

The aims of this study were to identify the profile of shear wave velocity (V_{s30}), and to analyze the classification of soil types of the Rammang-Rammang Maros Karst Area based on V_{s30} value. This work was carried out at the Rammang-Rammang Maros Karst Area, Salenrang and Bontolempangan Village, Bontoa District, Maros Regency, South Sulawesi. Microtremor data were analyzed using the Horizontal to Vertical Spectra Ratio (HVSr) method to obtain the H/V curve representing the

dominant frequency and amplification values. The H/V curve will be analyzed to produce an HVSR inversion that shows the ground profiles based of the shear wave velocity. The Vs30 values were obtained in the range from 310.382 to 496.142 m/s. The responses of rocks to the vibration of seismic waves passing through them will vary depending on the type of rock. The characteristics of the rock response can indicate the specifications of a rock type. Based on the Vs30 values obtained, it can be analyzed that the soil types at the research site are included in the classification of hard soil, dense, and soft rock and several other points are included in the classification of medium soil.

Keywords: Rammang-Rammang, Microtrmor, HVSR curve, HVSR inversion, wave velocity

ABS-ICMSCE-24229

**A Study on Program Development and Management
of a First-Year Experience Program for STEM
Human Resources: Focusing on Design and
Effectiveness of Online Learning due to COVID-19**

TOMOTAKA KURODA

Tama University / Shizuoka University
kuroda.tomotaka.17@shizuoka.ac.jp

STEM Human Resources are deeply linked to the economic development of the region. In addition, the global pandemic of COVID-19, which began in 2020 and lasted for several years, had a tremendous impact on many

educational activities, including university education. In this study, I focused on online in 2020 and onsite courses in 2019, in the early stages of the COVID-19 infection expansion. I examined what educational effects online classes, well-designed and implemented in the First-Year Experience Program. The participants were first-year undergraduate students majoring in STEM at a middle-level university in Japan who were enrolled in a class designed to teach communication skills, logical thinking, and academic skills. Specifically, I analyzed the pre and post-class questionnaire survey responses of the 2019 and 2020 students. I compared their sense of growth against the elements proposed by Japan's Ministry of Economy, Trade and Industry (METI) regarding fundamental competencies for working persons (11 items, 4-point methods) and the Next Generation Science Standards 's 8 Practice (8 items, 5-point methods). As a result, of the 19 items that did not show improvement after the class, one item was in 2019 and two items were in 2020. In addition, all 17 items in the pre and post class t-test were 10% significantly different, and no credible year-to-year differences could be confirmed. These results suggest that well-designed online classes may guarantee the same educational effects as onsite classes. Future studies could expand the scope of our studies to include changes in learners over time and interviews for students.

Keywords: First-Year Experience, Higher Education, STEM education, On-line education, COVID-19

ABS-ICMSCE-24231

**Review of Literature on Sound Wave Concepts:
Research Variables and Teaching Strategies**

Dandan Luhur Saraswati, Ida Hamidah, Andi Suhandi,
Achmad Samsudin

Pendidikan IPA, Universitas Pendidikan Indonesia
dandanluhur@gmail.com, idahamidah@upi.edu,
andi_sh@upi.edu, achmadsamsudin@upi.edu

The aim of this study is to offer a thorough overview of the concept of sound waves, focusing on research variables and teaching strategies. This article draws on research from major international databases like Scopus and Web of Science, utilizing content analysis techniques such as article identity analysis, educational information, approaches used, and variables measured. The research on sound waves indicates that qualitative, quantitative, and mixed methods can be employed to examine various variables. These findings emphasize the importance of employing diverse teaching strategies to effectively teach the concept of sound waves and measure different variables from a practical perspective in an educational context. Furthermore, our review provides a comprehensive list of common research variables that will serve as a valuable resource for educators and researchers aiming to enhance sound wave research. This systematic review also underscores the need for further research into effective teaching strategies for sound waves and offers valuable insights for educators and researchers.

Keywords: Sound wave, Literature review, Instructional Techniques, Teaching strategies

ABS-ICMSCE-24237

**The Usage of Comics in Physics Learning: A
Systematic Review of the Indonesian Research
Literature**

Ghaida Prinisa Achmad, Muslim, Dadi Rusdiana
Universitas Pendidikan Indonesia
ghaidaprinisa@upi.edu, muslim@upi.edu,
dadirusdiana@upi.edu

In today's digital age, visual components influence all aspects of life, including education. Comics made up of the interaction of written and visual information might have two goals: teaching scientific concepts effectively and raising student interest. This study aims to analyze the development of comics in physics learning based on the needs of the process and learning outcomes. This study reviews comics in physics learning and provides recommendations for future research and practices. This paper presents a literature review based on 43 studies published in journals between 2018 and 2023, found in Scopus and local databases. The review identifies the status and trends in the use of comics in education in Indonesia, its impact on the learning process, and opportunities for developers and practitioners. The trend of research development shows that the use of comics in physics learning in Indonesia fluctuated. The results of the data analysis show that learning physics with comics can stimulate students' learning abilities well. However, most studies lacked teacher involvement and explored the interaction between students and comics. Thus, the authors invite future studies to focus on what students

learn through comics through the implementation of an instructional intervention.

Keywords: A Systematic Review, Comics, Indonesia, Physics Learning

ABS-ICMSCE-24243

Assessing and enhancing creativity in a laboratory course with collaborative problem-solving laboratory

Saiyidah Mahtari, Syihabuddin, Agus Setiawan, Mustika Wati

Universitas Pendidikan Indonesia

saiyidahmahtari@upi.edu, Syihabuddin@upi.edu,
agus_setiawan@upi.edu, Mustika_pfis@ulm.ac.id

The purpose of this study is to document the creativity with which preservice physics teachers designed their physics labs. A consistent and clear way to gauge the level of creativity in laboratory results is lacking. As such, a rational system for fostering and evaluating their creativity is required. This study presents a collaborative problem-solving laboratory technique based on practicum for a practicum course in fundamental physics, backed by an assessment system that analyses creativity using a rubric. Twenty students studying physics education participated in the study. Reviewing practicum assistants, performance evaluations, and student input were all used in the data collection process. The system analysis made it quite evident how improving creativity is benefited by

the collaborative problem-solving laboratory-based practicum.

Keywords: creativity, collaborative, laboratory, problem-solving

ABS-ICMSCE-24244

**The Implementation of Digital Technology in
Mathematics Learning: A Systematic Literature
Review**

Woro Anglia Banda Sutomo, Turmudi
Universitas Pendidikan Indonesia
woroanglia22@upi.edu, turmudi@upi.edu

In digital era, technology has become an integral part of the educational process, including in mathematics teaching. This research is a systematic literature review. The aim of this study is to examine the use of digital technology in mathematics learning through a systematic literature review method. This review identifies and analyzes research that has been conducted on the implementation of various digital technologies in mathematics learning. The method used in this study includes a literature search from various academic databases using specific keywords related to digital technology and mathematics learning. The selected studies were then analyzed based on predetermined inclusion and exclusion criteria. Based on the publication status analysis, 49 research articles published in international journals with scopus indexed were found.

The results of these 49 articles indicate that research articles on digital technology during the period of 2020-2024 have not shown significant increase. Furthermore, the use of digital technology has a positive impact on mathematics learning, influenced by several factors such as student factors, teacher factors, and technological factors. Therefore, this Systematic Literature Review (SLR) provides valuable insights for further development in the integration of digital technology in mathematics education.

Keywords: digital technology, educational technology, learning media, mathematics learning,

ABS-ICMSCE-24245

**Analyzing college grade Javanese Students'
Conceptions: How Rasch analyzed students'
understanding of Physics Education Concepts?**

Rizal Adimayuda, Achmad Samsudin, Andi Suhandi,
Endi Suhendi

Universitas Pendidikan Indonesia
rizal.adimayuda@gmail.com

Developing and assessing instruments to diagnostic student's conception have been evolving based on education now. Education shall have innovation, especially for a teacher to teach any abstract concept that makes student capable to understand. This research has been utilized by 3D+1I model method (Defining, Designing, Developing and Implementing). There are 20

of participants who involved in this research (11 males students called “nang” and 9 females students called “nok” with an average age around 16 years old of Javanese tribe). The Instrument of MCMI consists 14 questions which has been already analysed by Rasch. There are six categories to know students’ conception that are Sound Understanding (SU), Partial Positive (PP), Partial Negative (PN), Misconception (MC), No Understanding (NU), and No Coding (NC). The research aims to develop and to assess conceptions of 10th grade Javanese student on Momentum and Impulse concept using PDEODE with Multitier Close-ended Momentum and Impulse (MCMI) Instrument.

Keywords: Rasch analysis, Close-ended Momentum and Impulse (MOMI) Instrument, Javanese-students, conception

ABS-ICMSCE-24266

Development of Biology Learning Media: E-Magazine Results of Field Research on Water Pollution in The Cigayam River to Increase Students' Awareness of River Conservation

Rita Retnowati, Dr. Rita Istiana, M.Pd.

Universitas Pakuan

Ritaretnowati@unpak.ac.id, rita_istiana@unpak.ac.id

One of the issues affecting rivers is pollution resulting from direct waste discharge into the water, which diminishes water quality. An example of such pollution

arises from natural stone processing activities in the Dukupuntang District, potentially polluting the Cigayam River in Cirebon Regency. Field research indicates that the river pollution falls within the moderate category. To address this issue sustainably, an educational initiative using e-Magazine learning media was implemented for school students in Cirebon Regency. This Study aims to enhance students' awareness of river conservation. The research adopts the Research and Development (R&D) approach, employing the ADDIE model (Analyze, Design, Develop, Implement, Evaluate). The study was conducted from January to June 2024, with trials involving students from SMAN 1 Jamblang, specifically Class XI MIPA 1 for the academic year 2023/2024. A limited field trial was performed using a one-group pretest-posttest research design. Results demonstrate that the developed e-Magaazine learning media is highly viable, supported by material expert assessment at 88.28% and media expert assessments at 85.97%. The instrument measuring student awareness of river conservation was validated with a high Aiken index of 0.81. Moreover, the e-Magazine learning media significantly increase students' awareness of river conservation from moderate to high levels, with an 8.80% increase and an average n-gain of 0.53.

Keywords: Students' awareness of river conservation, river pollution, E-Magazine, ADDIE

ABS-ICMSCE-24008

Enhancing Problem-Solving Skills in Biology using Problem-Based Learning integrated with Reading Questioning Answering Model

Rifanissa Eka Pratiwi, Siti Zubaidah, Vivi Novianti
Universitas Negeri Malang
rifanissa.eka.p.8@gmail.com,
siti.zubaidah.fmipa@um.ac.id,
vivi.novianti.fmipa@um.ac.id

Problem-solving skills help students to face the complexity of real, uncertain problems by finding various solutions. Problem-solving skills can be trained by applying a learning model involving active students, namely Problem-Based Learning integrated with Reading Questioning Answering (PBL-RQA). This research aims to describe the effectiveness of the PBL-RQA model on students' problem-solving skills. This research is a quasi-experiment that uses the nonrandomized control-group pretest posttest design. The research subjects were 96 students in class VIII of SMP Negeri 1 Kamal in Bangkalan Regency, East Java, Indonesia, who were distributed into three classes, namely VIII A (experimental class, taught using the PBL-RQA model), VIII C (control class, taught using the PBL model), and VIII D (control class, taught using the RQA model). Problem-solving skills were measured using a test instrument in the form of a description provided via Google form. Then, the results obtained were analyzed using the ANCOVA test, which had a significance level

of 5%, and the test with the least significant difference (LSD) was continued. The ANCOVA test results show that the three learning models affect increasing problem-solving skills with a p-value of 0.001. The LSD test also indicates that the PBL-RQA model significantly affects problem-solving skills compared to other learning models. Based on the research results, the PBL-RQA model has the best influence on improving students' problem-solving skills compared to PBL and RQA. Things that need to be considered during the implementation of PBL-RQA are providing apperception and ice-breaking to motivate students' interest in learning and the need to optimize time during presentations, discussions and assessments of summary assignments.

Keywords: PBL, RQA, Problem-Solving Skills

ABS-ICMSCE-24012

Does the Reading Concept Mapping Think Pair Share Model Improve Students' Collaboration Skills?

Irna Kurniaty, Siti Zubaidah, Sitoresmi Prabaningtyas

Universitas Negeri Malang

irna.kurniaty.2203418@students.um.ac.id,

siti.zubaidah.fmipa@um.ac.id,

sitoresmi.prabaningtyas.fmipa@um.ac.id

Collaboration skills in students are about working together to complete tasks or projects and, building solid relationships, solving problems collectively, and creating better outcomes to achieve common goals. Collaboration

skills can be cultivated by applying cooperative learning models, such as Reading Concept Mapping Think Pair Share (REMAP-TPS). This research aims to describe the effectiveness of the REMAP-TPS learning model on students' collaboration skills. This study was conducted at SMA Negeri 9 Malang, Lowokwaru, East Java, Indonesia, during the first semester of the academic year 2023/2024. It employed a quasi-experimental design with a non-equivalent pretest-posttest. The respondents were from classes X IPA 3 and X IPA 4, totaling 70 students. Data were collected through self-assessment and peer-assessment questionnaires and observation sheets to measure collaboration skills. The research findings indicate a significant difference in collaboration skills taught using REMAP-TPS compared to TPS, as evidenced by the p-value from the One-Way ANCOVA analysis being $0.00 < 0.05$. There was a significant improvement in collaboration skills, reaching a percentage score of 76.72%. Based on these results, it is confirmed that using the REMAP-TPS Learning Model with the assistance of the XMind application effectively enhances students' collaboration skills. This suggests that the REMAP-TPS learning model with the XMind application can be considered a viable alternative to improve students' competency in collaboration skills. Things that need to be considered in implementing the REMAP-TPS model are optimizing the use of time, controlling student activities, and involving observers who can help monitor more closely during the learning process.

Keywords: Remap-TPS, Xmind, Collaboration Skills

ABS-ICMSCE-24017
**Developing a Framework of Students' Application of
Conceptual Understanding in Designing Sensemaking
Processes**

Heesoo Ha
Seoul National University
heesooha719@gmail.com

Teachers often face challenges in supporting students in designing processes to make sense of natural phenomena. A primary challenge arises from the ambiguity surrounding how students apply their conceptual understandings in this process. This study aims to propose a framework for understanding student application of conceptual understandings in designing sensemaking processes. To achieve this goal, this study qualitatively examined 14 small-group students' design of their sensemaking processes. Students' conceptual understandings were categorized into those about structure, function, and mechanism of natural entities. The application of each type of conceptual understandings varied according to the epistemic criteria students addressed to examine and develop sensemaking processes. First, students examined the interestingness of natural phenomena, using their conceptual understandings of the structure and function of entities within natural phenomena to identify a target phenomenon. This process involved verifying their existing knowledge to determine the need for new understanding. The second criterion was the feasibility of investigating specific variables with given resources. Here, the students relied on their conceptual understandings of the structure and function of

entities corresponding to each variable to assess investigability. The third epistemic criterion involved examining whether the factors of target phenomena expressed in everyday terms could be translated into observable variables capable of explaining the phenomena. Conceptual understandings related to the function of entities were used to translate everyday expressions into observable variables and vice versa. Students' conceptual understanding of a comprehensive mechanism was used to connect the elements of the phenomenon and use them as potential factors to explain the target phenomenon. This study contributes to elucidating how a process of sensemaking can be developed with students in the science classroom.

Keywords: sensemaking, designing sensemaking processes, conceptual understanding, epistemic criteria

ABS-ICMSCE-24040

Development of teaching materials to visualize various scientific phenomena such as the bactericidal action of ultraviolet rays with bioassays using lactic acid bacteria

jota sakashita, Fumiko Okiharu

Tokyo University of Science

sjota196022@gmail.com, okiharu@rs.tus.ac.jp

In this study, we examined the development of teaching materials that can visualize the bactericidal action of ultraviolet rays by using lactic acid bacteria as a bioassay.

After spraying the diluted solution of *Lactobacillus bulgaricus* OLL1073R-1 strain and *Lacticaseibacillus casei* strain shirota from a mist bottle to MRS agar, cover half with aluminum foil, irradiate with ultraviolet rays and sunlight, and 48 hours 40 °C. By using the area covered with aluminum foil as a control, the comparison of the number of colonies with or without ultraviolet irradiation or sunlight was clarified, and the visualization and quantification of the bactericidal action was demonstrated.

The results of practicing the teaching materials developed in this study in a workshop for high school students confirmed that they improved their awareness and understanding of the benefits and harms of the bactericidal action of ultraviolet rays.

Keywords: Bioassay, Bactericidal action, Lactic acid, Visualization, Ultraviolet ray

ABS-ICMSCE-24046
**THE POTENTIAL OF TURTLE CONSERVATION
AT PELANGI BANTUL BEACH YOGYAKARTA
AS A SOURCE FOR BIOLOGY LEARNING
SUSTAINABLE**

Mira Kusumaningrum, Slamet Suyanto, Suhartini, Paidi
Yogyakarta State University
miraesti.2022@student.uny.ac.id,
slamet_suyanto@uny.ac.id, suhartini@uny.ac.id,
paidi@uny.ac.id

One of the goals in the SDGs' mission is Goal 14 - Life Below Water. This mission aims to conserve and sustainably use marine resources, oceans, and seas for sustainable development. Through direct field observations at Pelangi Beach, Bantul and literature studies, an analysis of local potential has been carried out with a focus on three aspects: 1) availability or completeness, related to the presence of learning resources in the vicinity; 2) suitability or relevance, related to the alignment of learning resources with the learning objectives; and 3) ease or feasibility and eligibility, related to the ease of organizing, developing, and utilizing the learning resources. The results show that Pelangi Beach has turtle conservation and various educational activities such as eco-brick making and pandan planting around the beach. Turtle conservation can also be a suitable subject for learning, aligning with the learning achievements in the independent learning curriculum, such as ecosystem, biodiversity, and environment. Additionally, the availability and completeness of the beach are complemented by the ease

of access to Pelangi Beach. Based on this analysis, it can be concluded that Pelangi Beach has the potential to be a source of learning for Biology.

Keywords: SDG's, Pelangi Beach, Turtle Conservation, Availability, Relevance, Eligibility, Biology Learning

ABS-ICMSCE-24054

Exploring the effect of students' and professors' religious identity on increasing students' perceived compatibility between evolution and religion

Rahmi Aini, Dr. M. Elizabeth Barnes

Middle Tennessee State University

rqa2a@mtmail.mtsu.edu, liz.barnes@mtsu.edu

Evolution is fundamental to biology, yet it is still controversial among biology students, particularly due to perceived conflicts with religious beliefs. In the United States, efforts have been made to address this through Religious Cultural Competence in Evolution Education (ReCCEE) practices, aiming to foster greater acceptance and more inclusive evolution learning environments. These practices involve emphasizing the potential compatibility between religion and evolution, such as by teaching the nature of science, providing religious role models, and avoiding negativity towards religion. In our research, we employed a randomized controlled study with three groups: 1) control without any ReCCEE practice, 2) ReCCEE practice with a non-religious professor, or 3) with a religious professor. A total of 2625

college students in the US from 18 introductory courses across 9 states participated, randomly assigned to watch one of three evolution instructional videos presented by the same actor-professor. Each video covered evolution's definition, explanatory power, and major evidence. Before and after watching their assigned video, students completed established surveys to measure their perceived conflict and compatibility between evolution and religion, as well as acceptance of evolution. We compared outcomes across the three groups and examined interactions between students' religious affiliations and the instructional video received. Results indicated that ReCCEE practices increased the perception of compatibility between evolution and religion, reduced the perception of conflict, and led to greater evolution acceptance. These findings highlight the effectiveness of such practices in promoting understanding and acceptance of evolution, regardless of students' religious backgrounds. Finally, we find that a non-religious professor can have a greater impact on their atheist students, which may contribute to increasing atheist students' ability to effectively communicate about evolution to religious audiences in the US in the future.

Keywords: Evolution Education, Religion, Interdisciplinary

ABS-ICMSCE-24057

Teachers' Perceptions of Biology Learning Based on Numeracy Literacy

Waliyyatu Azzahra, Sariwulan Diana, Eni Nuraeni

Universitas Pendidikan Indonesia

waliyyatuazzahra@upi.edu, sariwulwul@yahoo.co.id,

eninuraeni@upi.edu

The development of biology is increasingly complex with the increasing use of numerical data and information. Numeracy literacy is important for students to understand biological concepts in depth. This study aims to determine teachers' perceptions of Numeracy Literacy-Based High School Biology Learning. A total of 25 high school teachers who teach biology in public and private schools participated in this study. The instruments used in this study were questionnaires and interviews. The study results showed that teachers have a positive view of the importance of numeracy literacy-based biology learning, but its quality needs improvement. It was found that 84% of teachers felt they had sufficient knowledge to integrate this learning, but still needed guidance to optimize it. In addition, 56% of teachers stated that students showed enthusiasm for numeracy literacy-based biology learning, but some teachers found that students were less enthusiastic. Factors such as students' lack of basic mathematical knowledge and low data analysis and interpretation skills are the causes. From the results of the study, it is necessary to improve learning strategies to achieve higher learning effectiveness and create an interesting and relevant learning environment for students

so that they can be actively involved in learning material that involves numeracy aspects.

Keywords: Numeracy Literacy, Biology Learning, Teacher Perception

ABS-ICMSCE-24078

Exploring the Effect of the Problem-Based Learning Model on Understanding Human Heredity Patterns: A Quasi-Experimental Study Among Secondary School Students.

Jasmine Nurul Izza

Universitas Negeri Malang

jasmine.nurul.2303418@students.um.ac.id

Good health and well-being are becoming increasingly crucial as the world faces diverse and varied challenges related to life and disease. To rise to this challenge, the education sector must equip students with the ability to differentiate between hereditary and infectious diseases. Teaching and learning about the patterns of human heredity mechanisms pose significant challenges. Whereas comprehending genetic mechanisms enables the capacity to offer causal interpretations for genetic occurrences and build good interpretation of students about genetic phenomena. This study aims to assess the impact of Problem-Based Learning (PBL) on the understanding of human hereditary patterns, critical thinking abilities, and learning outcomes in biology education. Given the crucial role of adolescence in

managing their health, promoting health literacy through biology education becomes imperative. Central to health literacy is critical thinking, a skill sharpened by the PBL model. By fostering engagement with biological concepts, this approach equips students with effective tools to navigate health-related challenges. Conducted as a quasi-experimental study, this research involved 60 secondary school students. Pre-and post-tests were administered to gauge knowledge and skills in human heredity. The findings revealed significantly higher post-test scores in knowledge acquisition among the experimental group. With p value level = $0,00 < \alpha = 0,05$, indicating the efficacy of the PBL model. Additionally, students exhibited elevated levels of critical thinking, suggesting a deeper understanding of biological concepts and their implications for health. This study underscores the importance of innovative pedagogical approaches, such as PBL, in mitigating holistic development in biology education.

Keywords: human heredity, biology, PBL, SDGs

ABS-ICMSCE-24097

Optimizing Science Literacy Skills for Disaster Mitigation in Biodiversity: A Sustainable Education Approach

Anisa Oktina Sari Pratama, Dzulhi Maulana Yusup, Nur Hidayah, Raicha Oktafiani, Aryani Dwi Kesumawardani
Universitas Islam Negeri Raden Intan Lampung
Pratamanisa15@gmail.com

The importance of a deep understanding of biodiversity and disaster mitigation efforts is becoming increasingly essential in the context of environmental protection. This research aims to explore enhancing the scientific literacy skills of prospective biology teachers in connecting the concept of biodiversity with disaster mitigation efforts, using a sustainable education approach. Through this analysis, we investigate the extent to which sustainable learning approaches can improve students' understanding of scientific concepts related to biodiversity. We also examine their ability to design and implement effective mitigation actions. The sample for this research consisted of 60 prospective biology teachers. The methods used were tests and interviews. The findings from this research provide valuable insight into the important role of sustainable education in preparing future generations to face global environmental challenges. Thus, efforts to integrate sustainable education approaches in the context of biodiversity learning and disaster mitigation become a crucial strategy in building a more knowledgeable and ecologically and economically sustainable society.

Keywords: Science Literacy, Disaster Mitigation, Biodiversity, Sustainable Education

ABS-ICMSCE-24106

Empowering Students' Collaboration Skills Through Remap-STAD Assisted by The GitMind Application on Biology Learning

Rena Silvia Agustina, Prof. Dr. Siti Zubaidah, M.Pd,
Hendra Susanto, S.Pd., M.Biomed., Ph.D
Universitas Negeri Malang
rena.silvia.2203418@students.um.ac.id,
siti.zubaidah.fmipa@um.ac.id, hendrabio@um.ac.id

Students' collaboration skills at school still need attention to be empowered and improved. Some students at school experience difficulties with this skill, so they are still in the low category. This research aims to determine the effect of the reading concept mapping-student teams achievement divisions (Remap-STAD) learning model assisted by the Gitmind application on the collaboration skills of class X students on Biology learning. This research is a type of Quasi-Experimental research. The research design used was Pretest-Posttest Nonequivalent Control Groups Design, participants in this research were 70 students of class X SMAN 9 Malang, East Java, Indonesia, the class used was class X MIPA 8 (experiment class using the Remap-STAD model assisted by the GitMind application) and X MIPA 9 (control class using the STAD model). Data collection techniques were carried out using self-assessment questionnaires and peer-assessment of collaboration skills. Collaboration skills refer to indicators such as works productively,

Demonstrates respect, compromises, and shared responsibility everyone contributes. Collaboration skills data were analyzed using the One-Way ANCOVA test at a significance level of 5%. Then, proceed with the LSD test. The research results show that the Reading Concept Mapping-Student Teams Achievement Divisions (Remap-STAD) learning model assisted by the Gitmind application affects students' collaboration skills. This is proven by a significance value of 0.000. Therefore, the Reading Concept Mapping-Student Teams Achievement Divisions (Remap-STAD) learning model assisted by the Gitmind application can be used as an alternative learning model to improve students' collaboration skills on Biology learning.

Keywords: Remap-STAD, GitMind, Collaboration Skills

ABS-ICMSCE-24107

Remap-TPS integrated Flipped Classroom to Enhance Students' Digital Literacy in Biology Learning

Suci Arsi Ramdhani, Prof. Dr. Siti Zubaidah, M.Pd., Dr.
Sitoresmi Prabaningtyas, S.Si., M.Si.
Universitas Negeri Malang
suci.arsi.2203418@students.um.ac.id,
siti.zubaidah.fmipa@um.ac.id,
sitoresmi.prabaningtyas.fmipa@um.ac.id

Digital literacy is very important, but various research results show that high school students' digital literacy is

still low and needs to be improved. The Remap-TPS integrated Flipped Classroom requires students to utilize technology in learning. This process has the potential to empower students' digital literacy. This research aims to determine the effect of the Remap-TPS integrated Flipped Classroom on students' digital literacy in biology learning. The research design used was a pretest-posttest nonequivalent control group design. The research sample consisted of 72 class X students at SMAN 9 Malang, East Java, Indonesia. They were divided into an experimental class and a control class. The experimental class was taught using the Remap-TPS integrated Flipped Classroom, while the control class was taught using the TPS model. Data was collected through pretest and posttest using questionnaires referring to digital literacy indicators consisting of behavior towards technology, technical, cognitive, and social-emotional. Data analysis was carried out using the ANCOVA test with a significance level of 5%, then continued with the LSD test. The research results show that the Remap-TPS integrated Flipped Classroom affects students' digital literacy. Therefore, this model can be used as an alternative learning model to increase students' digital literacy in biology learning.

Keywords: Digital Literacy, Flipped Classroom, Remap-TPS

ABS-ICMSCE-24115
**Need Analysis of Plant Metabolism Learning Module
Assisted by In-silico Bioinformatics**

Risanti Dhaniaputri
Universitas Ahmad Dahlan
risantidhania@pbio.uad.ac.id

In-silico bioinformatics is a technique to support the biological research and learning using technological approach. Bioinformatics is starting to be widely used in molecular biology research, genetics, taxonomy, microbiology, biotechnology, and physiology. Bioinformatics approach based on searching biological databases which contain various molecular data information used in biological research and learning. This research aims to observe the needs of lecturers and students regarding the use of teaching materials for plant metabolism courses based on bioinformatics. The respondents involved were two lecturers and fifty-eight students have enrolled in the course on plant metabolism in even semester. Instruments used to assess the lecturers' and students are questionnaires that distributed directly and using Google Form. The research results showed that all lecturer and student respondents agreed that teaching materials would be prepared and developed in the form of module to improve the students' content-knowledge, understanding, and process skills in studying plant metabolism assisted by in-silico bioinformatics. The teaching module prepared consists of plant metabolism basic concepts, phytochemical compounds, and analysis techniques by using in-silico.

Keywords: Bioinformatics, In-silico, Module, Plant Metabolism

ABS-ICMSCE-24146

Using the Botanical Eco-gamification Program to Support Sustainable Practice in Sustainable Development Topics

Zuliande Zidan

Indonesia University of Education

zuliandezidan@upi.edu

The implementation of sustainable development practices often lacks contextualization when only taught through photos or videos in the classroom. An outdoor learning strategy that incorporates technology, challenging and stimulating is needed to support generation Z's learning more effectively. A program called Botanical Eco-gamification uses technologoy and gamification principles to blend active learning with sustainable development practices at UPI Botanical Gardens. This research aims to measure the effectiveness of the Botanical Eco-gamification program on students' mastery of concepts on the topic of sustainable development. The research method used is quantitative research with a one-group pretest-posttest design with instruments in the form of pre and post-tests and response questionnaires. Data in the form of students' average initial and final grades were analyzed using N-Gain and mastery learning. Student responses regarding the material applicability, program presentation and competencies they had learned were all

descriptively examined using achievement percentages. The research results showed that there was an increase in students' mastery of concepts in the low category (N-Gain: 0.17). Nonetheless, almost all students (92.75%) achieved mastery learning level on the topic of sustainable development. The sustainable development practices taught in the program were overall responded very well (86.79%) by students.

Keywords: SDGs, Outdoor Learning, Gamification, Active Learning, Sustainable Developments

ABS-ICMSCE-24149

**The Effect of a Virulent Attack Role Playing Game
on Enhancing Students' Collaboration Skills**

Natasya Adiba Zahrah, Sinta Kharomah, Muhamad

Justitia Ramadhan, Deny Setiawan, Siti Zubaidah

State University of Malang

natasya.adiba.2003416@students.um.ac.id,

sintakharomah78@gmail.com,

justitiarmdhn@gmail.com, setiawan.fmipa@um.ac.id,

siti.zubaidah.fmipa@um.ac.id

Collaboration skills are one of the 21st century skills that are important for every individual to have. Game-based learning media has been proven to motivate and engage students in the context of learning and developing collaboration skills. This research discusses the design and use of educational role-playing media for learning biology, specifically virus concept, aimed at enhancing

students' collaboration skills. The role-playing game used is Virulent Attack, adapted from the Werewolf game. The developed learning media was implemented with 29 students of class 10-D of senior high school. When applying the developed learning media, students' collaboration skills were proven to increase. This is evidenced by the comparison of pretest and posttest results from observers and students, which showed a significance value of 0.000, smaller than the t-table value of 0.05. Interviews conducted with several student representatives showed positive results, with students expressing that their experiences and participation in learning provided them with a useful and enjoyable learning experience. The results of this study not only underscore the potential of role-playing in an educational setting but also highlight the practical implications of incorporating this kind of media into the biology curricula to enhance students' understanding and participation in learning.

Keywords: Collaboration skills, learning media, role-playing, virus

ABS-ICMSCE-24156
**Developing Sustainability Competencies of Critical
and Anticipatory Thinking through Botanical Eco-
Gamification Program.**

Asyah Hastika, Dr. Saefudin, M.Si, Dr. Bambang
Supriatno, M.Si

Universitas Pendidikan Indonesia
asyahdwi44@upi.edu, adenimi@hotmail.com,
bambang@upi.edu

The integration of ESD in the learning system in higher education is very important as an effort to create a generation that has sustainability competencies. This research aims to develop sustainability competencies, especially critical thinking and anticipatory competencies through the implementation of Botanical Eco-Gamification Program. This Learning program integrates gamification elements with environmental issues to create a more interactive and relevant learning experience. The pre-experimental method with one group pretest-posttest design was used for this study. The subjects of this study were 72 undergraduated students of biology education who contracted Biodiversity, Environmental Knowledge and Conservation courses at one of the universities in Bandung, West Java. The sampling technique used was convenience sampling. Data were collected through written tests before and after the intervention and analyzed using the N-Gain formula. The results showed that there was a significant increase in students' critical and anticipatory thinking competencies with N-Gain in the moderate category (0.57). The increase in the mean score of sustainability competence with the initial mean

score in the good category (66.84) increased to very good (85.65). This finding indicates that the integration of eco-gamification in learning can be an effective strategy in developing students' sustainability competencies, especially in critical thinking and anticipatory competencies.

Keywords: Sustainability Competencies, Botanical Eco-Gamification, Critical Thinking, Anticipatory Thinking

ABS-ICMSCE-24159

**From Experience to Expertise: A Case Study of
Biology Teachers' Pedagogical Content Knowledge
Development**

Chunlei Zhang

East China Normal University

chlzhang@bio.ecnu.edu.cn

PCK is the experiential knowledge and skills acquired through classroom experience and it is the integrated set of knowledge, concepts, beliefs, and values that teachers develop in the context of the teaching situation. Research showed that experienced teachers have more integrated and developed PCK than beginning teacher (Lee, Brown, Luft, & Roehrig, 2007). But, how expert teachers develop their PCK? In this study, PCK is defined as a set of knowledge that teachers use to teach topic specific content. Five high school biology expert teachers participated in this study. They are interviewed to review their knowledge development processes. Concept maps

are drew by the interviewer and the teacher together to identify expert teachers' PCK components development and their relationships between each other. Then they were also interviewed about how they use these knowledge to design and teach a specific lessons based class observations or teaching video records. Based on interview and concept maps analysis, 5 explicit themes were identified: (1) Subject matter knowledge;(2) Student; (3) Pedagogy; (4) Class teaching; (5) Self-identity. Expert teachers developed their PCK components in different order and by different means, which were significantly driven by the teacher's personal study and work experiences. Implications and recommendations for teacher preparations and professional development programs were discussed.

Keywords: Pedagogical Content Knowledge; case study; biology teachers; teacher knowledge; concept maps

ABS-ICMSCE-24210

Evaluation of Instruments Assessing Cognitive Thinking Abilities of Students in Genetics Lectures

Iffa Ichwani Putri, Adi Rahmat, Riandi, Lala Septem
Riza

Universitas Pendidikan Indonesia

iffa.ichwani@upi.edu

This study aims to determine the quality of test instruments in measuring the level of thinking skills in the cognitive system dimension of biology education students

in genetics lectures. The level of thinking ability measured based on the New Marzano Taxonomy. This cognitive system dimension consist of 4 levels: retrieval, comprehension, analysis, and knowledge utilization. The research method used was descriptive quantitative, with respondents as many as 116 prospective biology education teacher students in 6 semester who had attended genetics lectures. The instrument in this study is a multiple-choice test question. Data analysis using the Rasch Model-dichotomy. The results showed that the Alpha Cronbach value on the instrument was 0.81 (Very Good). Furthermore, person reliability is 0.63 (weak) and item reliability is 0.92 (Special). It was concluded that the interaction between the question items on the test instrument and the quality of the question items used to measure the level of thinking-dimensions of the cognitive system used was very good, but the consistency of answers from students was considered weak. Furthermore, polychotomy analysis is carried out to assess the essay instruments.

Keywords: Biology, Cognitive, Genetics, Thinking

ABS-ICMSCE-24217

**Innovative Biology Learning Integrated with
Character Value Education: Systematic study of
National Journal Article Indexed Sinta**

Diana Yusni, Yayan Sanjaya, Kusnadi

Universitas Pendidikan Indonesia

dianayusni@upi.edu, yayan@upi.edu, kusnadi@upi.edu

The urgency of innovative efforts in the midst of facing various challenges in implementing character value education in schools is the background of many studies in the educational sector in Indonesia. One of the strategies to implement character education is by integrating it with general learning, including biology learning. This study aims to examine biology learning innovations that are integrated with character values. The methodology used in this research is a survey approach that applies a cross-sectional study design on 45 research articles published in national journals with an index of Sinta 1-3 within the roughly recent five years, from March 2019 to March 2024. Based on the research results, the following data were obtained: The common type of research is the Research and Development (R&D) type, which aims to develop pedagogical aspects both in terms of approaches, methods, models, or character value-based biology learning media; The trending biology learning topics are integrating character values in the discussion of environmental and biodiversity materials; The subjects used as research targets are very varied, starting from junior high school students, high school students, undergraduate students, postgraduate students, teachers, lecturers to the general public, with the most research

targets being class X high school students; And the value of environmental care is the most integrated character value. Thus, based on the results, a number of suggestions are made in light of the study's findings, which may help educators and future researchers create creative biology teaching environments that integrate character education.

Keywords: Journals of biology education, Biology learning, Integration, Character values education

ABS-ICMSCE-24235

Private High School Student's Environmental Awareness

Farhan Alfiansyah, Yayan Sanjaya, Mimin Nurjhani
Kusumastuti

Universitas Pendidikan Indonesia

farhan@upi.edu, yayan@upi.edu, emneka@gmail.com

The purpose of this research was to examine the environmental awareness of private high school students. This study aimed to investigate the level of environmental awareness among private high school students. A quantitative research approach was utilized, employing a questionnaire comprising 15 questions adapted from the Dunlap and Van Liere framework, using a 5-point Likert scale. The sample population consisted of 30 Environmental Awareness of private high school students. The study successfully assessed the environmental awareness of these students. The results revealed that 46.67% of students scored between 60-69,

33.33% scored between 70-79, and 20% scored between 80-90. On average, participants had a score of 72.22, which falls into the good category.

Keywords: Environmental awareness, Biology Education

ABS-ICMSCE-24242

Measuring Epistemic Knowledge in Biology Through Assessment: A Systematic Literature Review

Angga Dwi Saputra, Ana Ratna Wulan, Eni Nuraeni

Universitas Pendidikan Indonesia

anggasaputra043@upi.edu

In the evolving landscape of science education, epistemic knowledge is one of three keys to developing competencies in science education, including biology. Moreover, only a small number of studies comprehensively present research trends regarding epistemic knowledge research trends and the measurements carried out. This literature review aims to provide insight into epistemic knowledge assessment research in past decades. With the PRISMA 2021 guidelines, we carried out a systematic literature review method. 32 Journal articles were used & obtained from the Scopus and Springer databases. We decided to focus on several aspects to analyze; research methods, research subjects, used instruments, how to analyze data, and the scopes of science in the articles reviewed. The SLR findings show that few studies still provide an overview

of how to assess epistemic knowledge, specifically in Biology. Traditional biology assessments tend to focus more on content knowledge and thus do not fully capture how knowledge works. Data analysis shows that most of the research conducted used qualitative research methods, followed by mixed research methods. The most frequently reviewed research subjects are pre-service/prospective teachers, followed by teachers. In epistemic knowledge research, much of the data is analyzed qualitatively, this depends on the research methods used in most studies. Meanwhile, the scope of science that is most studied is holistic science, followed by physics. Based on these findings, this research provides a scientific contribution as a basis for stakeholders in developing research related to the assessment of epistemic knowledge of science, specifically in the scope of biology.

Keywords: Epistemic knowledge, Biology Learning Assessment, Research trends, Systematic Literature Review

ABS-ICMSCE-24247

The Use of Augmented Reality as an Innovative Media in Biology Learning: A Literature Review

Yenni Verawati, Adi Rahmat, Yayan Sanjaya
Universitas Pendidikan Indonesia
yennivsagala@upi.edu, adirahmat@upi.edu,
yayan@upi.edu

Information technology in today's digital era has an essential influence on the development of science. Therefore, education is vital in shaping superior human resources and must integrate with digital technology. One of them is the use of Augmented Reality in learning. This research uses a literature review on using Augmented Reality in learning within the last ten years. Data were taken from fifteen biological education journals indexed by Sinta 2-4 as many as 20 articles. Some aspects analyzed were research variables, types of research, research subjects, instruments, data analysis methods, treatments used, and learning topics. The most studied variable was concept mastery, followed by learning motivation and critical thinking. The most common type of research was experimental research. The most common subjects studied were high school and junior high school students. Instruments that are often used are questionnaires and multiple choice and description questions. T-test analysis was the most widely used data processing method. The learning topics most discussed were the human respiration system and human digestion. The dominant research conducted was successful. Some recommendations are submitted as insights for teachers

and researchers to create a learning atmosphere that can integrate Augmented Reality into learning.

Keywords: journal of biology education, augmented reality, biology learning

ABS-ICMSCE-24262


Equity Education and Scientific Literacy in Online Learning: Integrating Technological Pedagogical Content Knowledge (TPCK) with Local Wisdom in Agroindustrial School Regions

SURATNO SURATNO

Universitas Jember


suratno.fkip@unej.ac.id

This study explores the integration of Technological Pedagogical Content Knowledge (TPCK) with local wisdom to enhance equity education and scientific literacy in online learning environments within agroindustrial school regions. The research aims to address the disparities in educational access and quality, particularly in rural and agroindustrial areas, by leveraging culturally relevant pedagogy and advanced technological tools. By incorporating local wisdom into the TPCK framework, the study seeks to create a more inclusive and effective educational model that resonates with students' lived experiences and cultural backgrounds. The findings are expected to demonstrate how this integrated approach can bridge the gap in educational equity and improve scientific literacy among students,



fostering a more inclusive and contextually relevant learning experience. The study employs a mixed-methods approach, combining quantitative data on student performance with qualitative insights from educators and students, to evaluate the impact of this integrated pedagogical strategy. The results will provide valuable implications for policymakers, educators, and curriculum developers aiming to promote equitable and high-quality education in agroindustrial regions.

Keywords: Equity Education, Scientific Literacy, Online Learning, TPCK, Agroindustrial



ABS-ICMSCE-24026
**DEVELOPMENT OF PjBL MODEL
THERMOCHEMISTRY PRACTICUM
WORKSHEET WITH THE CONTEXT OF
MAKING TAPE FROM CASSAVA (*Manihot
esculenta*) TO DEVELOP STUDENTS' SCIENCE
PROCESSING SKILLS (KPS).**

Abdul Wahid
Universitas Pendidikan Indonesia
aw140520@gmail.com

This study aims to produce a PjBL model thermochemistry practicum worksheet with the context of making tape from cassava to develop students' science process skills (KPS). The research method used is descriptive evaluative with the first type of developmental research model. The research stages include optimization of tape making experiments as the developed context, LKS development, LKS feasibility test and LKS comprehensibility test. Optimization was carried out to determine the optimum conditions for the process of making tape from cassava as the basis for preparing thermochemical practicum procedures on the developed LKS. Based on the optimization results, it is known that the concentration factor (yeast mass) and surface area (cassava pieces) of cassava can affect the heat exchanged during the fermentation process. The participants in this study consisted of 2 chemistry education lecturers and 1 chemistry teacher as validators in the LKS feasibility test and 26 students of class XI IPA one of the MA in Bandung

City as participants in the LKS comprehension test. Based on the results of the research that has been carried out, this study produces PjBL model thermochemical worksheets to develop students' KPS in the context of making tape from cassava with the results of the feasibility test in the very feasible category. In addition, the results of the student comprehension test showed 94.44% of the entire text was easy to understand and only 5.56% of the entire text was difficult for students to understand.

Keywords: worksheet, PjBL model, science process skills, thermochemistry, cassava tape

ABS-ICMSCE-24028

Reaction Rate of the Last Chemist: An Intertextual-Based Educational Game on the Concept of the Effect of Concentration on Reaction Rate

Clarysa Satari, Wiji, Tuszie Widhiyanti

Universitas Pendidikan Indonesia

clarysastr14@upi.edu, maswiji@upi.edu,

tuszie@upi.edu

This research aims to develop and produce a product in the form of intertextual-based educational game on the concept of the effect of concentration on reaction rate. Small-scale Research and Development (R&D) methods are used in the development of this educational game by applying learning principles, cognitive multimedia principles (Mayer), and game development principles (Reigeluth). This intertextual-based educational game

was developed under the name "Reaction Rate of the Last Chemist" which has 2D graphics and links three levels of chemical representation (macroscopic, sub-microscopic, and symbolic levels). The intertextual-based educational game developed has been validated by nine experts with different backgrounds (chemistry, chemistry education, multimedia). Expert validation is obtained using validation instruments which are then analyzed using Miles and Hubermann analysis techniques. The result obtained is that the game has been declared valid both on aspects of content, pedagogy, and multimedia with some suggestions for improvement. Responses to the educational game developed were obtained from 2 chemistry teachers and 30 high school students using questionnaires as data collection instruments. Teacher response data was analyzed with Miles and Hubermann while student response data was analyzed with the Guttman scale. The responses of teachers and students gave a positive response with several suggestions for improvement. The results obtained are clarity on static and dynamic characters and learning videos provided, navigation buttons that function properly, the suitability of chemical materials with learning principles so that they can be used for independent learning, and obstacles in educational game provide challenges and motivation for students.

Keywords: Educational Game, Intertextuality, Chemical Representation, Concentration Effect, Reaction Rate

ABS-ICMSCE-24050
**Student Perspectives in Implementing the Minimum
Competency Assessment (AKM) in Chemistry
Subjects**

Wangi Pusva Kartini, Nahadi
Universitas Pendidikan Indonesia
wangipusvakartini@upi.edu, nahadi@upi.edu

Minimum Competency Assessment (AKM) is the standard for assessing student competency through mastery of reading literacy and numeracy. AKM aims to measure the fundamental competencies needed by students to be able to develop their own capacity and participate positively in society and is one part of the government's target to prepare students to face the 21st century, namely students who have Critical thinking skills, Creativity, Communication skills, and Collaboratively. The aim of the research was to determine the perspective of class X students studying chemistry subjects at SMA Negeri x Kepahiang in implementing AKM on chemistry subjects. This research was conducted to improve the quality of learning and teacher assessment of students in chemistry learning. The method used is case study research with a qualitative descriptive approach. Students are asked to fill out a questionnaire, then continue with an interview. Interview with 10 students via google meet. The interview results were analyzed separately for each question and content analysis was carried out to examine the data in more detail. AKM results provide space for teachers and students to carry out a more efficient teaching and learning process thereby

increasing students' understanding of the chemical material provided.

Keywords: Minimum competency assessment, chemistry learning, numeracy, literacy

ABS-ICMSCE-24055

The Influence of HA/PVP Composition on the Mechanical and Barrier Properties of Polyblend HA/PVP Films as Biodegradable and Biocompatible Plastics

Gabriela Chelvina Santiuly Girsang, Dr. H. Budiman
Anwar, M.Si, Prof. Fitri Khoerunnisa, Ph.D
Universitas Pendidikan Indonesia
gabrielachelvina@upi.edu, budimananwar@upi.edu,
fitri@upi.edu

Conventional plastic made from petroleum is not naturally biodegradable, causing environmental pollution and health risks. This issue has led to the development of environmentally friendly plastics using biopolymers such as hyaluronic acid (HA). HA has been developed as a plastic film due to its non-toxic, biocompatible, and biodegradable properties. However, a new problem has emerged regarding the production cost of HA films because HA is relatively expensive. Therefore, specific engineering techniques are needed to reduce production costs while improving the quality of HA films. In this study, HA will be combined with the synthetic polymer PVP using physical blending technique, which can

enhance the formation of HA plastic films. This research aimed to determine the effect of the HA/PVP composition on the mechanical properties and barrier properties of HA/PVP plastic films. Studying the composition of HA/PVP is crucial to determine the optimum ratio for obtaining plastic films with optimal performance. The film's mechanical properties were examined through a tensile strength test, while its barrier properties were assessed via a water vapor transmission rate test. The results show that a high PVP content affected the tensile strength, elongation percentage, and Young's modulus of the plastic films. Additionally, the hygroscopic properties of PVP can significantly affect the barrier properties of the plastic films.

Keywords: Hyaluronic acid, Polyvinylpyrrolidone, Mechanical properties, Barrier properties, Biodegradable

ABS-ICMSCE-24056

Adsorptive properties of fly ash zeolites modified by zinc oxide and magnetite for clindamycin removal

Jessica Veronica, Dr. Galuh Yuliani, M.Si., Dr. H.

Budiman Anwar, M.Si.

Universitas Pendidikan Indonesia

sjessicaveronica@upi.edu, galuh@upi.edu,

budimananwar@upi.edu

Clindamycin is one of the most widely used antibiotic for the treatment of various bacterial infections, hence it is commonly detected pharmaceutical contaminants in

different water sources. One effort to reduce the contamination of clindamycin in a body of water is by adsorption method using sorbent materials. Fly ash (FA) is coal waste produced from coal combustion process in industries and is currently creating serious problems to human health. Fly ash can be converted to zeolites, a powerful sorbent materials, however the performance of zeolite fly ash (ZFA) is still considered low and its regeneration from solution is difficult. Therefore, this research aims to modify the ZFA using zinc oxide and magnetite to enhance its adsorption capacity and regeneration ability. The modified zeolites are then used as sorbent materials for clindamycin antibiotics removals. The methods used in this research are hydrothermal synthesis with an autoclave to obtain modified zeolite, adsorption testing using the batch system, and zeolite retrieval testing using a neodymium magnetic rod. The modified zeolite was characterized using X-Ray Diffraction (XRD) and adsorption testing was conducted using an Ultraviolet-Visible (UV-Vis) spectrophotometer instrument. Based on the results of characterization using XRD, it was found that ZFA/ZnO and ZFA/Fe₃O₄ are Na-P1 type zeolites and no longer found quartz or mullite minerals in them. Adsorption data showed that the optimum pH to adsorb clindamycin antibiotic was pH 6 with an adsorption percentage for ZFA/ZnO of 96.92% and ZFA/Fe₃O₄ of 75.38%. The magnetic properties of ZFA/Fe₃O₄ are much better than ZFA/ZnO so it will be easier to retrieve from the surface of the solution using a neodymium magnetic rod.

Keywords: ZFA/ZnO, ZFA/Fe₃O₄, adsorption, clindamycin, zeolite

ABS-ICMSCE-24061

TeachSynergy: A project to integrate SDGs in countries with limited resources

Michael Peetz

Carl von Ossietzky Universität

michael.peetz@uol.de

TeachSynergy is an innovative project aimed at supporting teachers nationally and internationally in incorporating scientific experiments from the STEM fields into their classrooms. In many countries, including Germany, and especially in regions with limited resources, conducting simple experiments in the classroom is often hindered by a lack of materials (Jones et al., 2018; Roden et al., 2018). Instead, teachers resort to using worksheets or videos, which reduces the hands-on scientific learning experience. TeachSynergy aims to address this issue by providing workshops and educational materials aligned with the Sustainable Development Goals (SDGs) of the United Nations, enabling teachers worldwide to overcome resource constraints and enhance the quality of science education (Amorós Molina et al., 2023). Following each workshop, an online evaluation captures participant feedback on content, structure, and applicability. Preliminary results from surveyed participants reveal unanimous satisfaction and a strong

intent to recommend the workshops to colleagues. Notably, a majority reported feeling equipped to integrate workshop experiments into their teaching practice. Collaborating closely with educational authorities, including the Western Cape Education Department, our workshops welcome educators from diverse school types, fostering inclusivity and collaboration. Our poster showcases the impact of our workshops and highlights our collaborative approach to enriching STEM education in resource-constrained environments. This poster will present our project as well as give examples from our four different topics (chemistry, biology, computer science and physics) and how a workshop could be built. It is designed to encourage readers to get in touch with us and ask about future collaboration possibilities.

Keywords: sustainability, STEM, Teacher Training, resource-constrained education, hands-on experiments

ABS-ICMSCE-24062

Empowering Teachers in education of sustainable development: Innovative Workshops in chemistry, biology and computer science with limited resources

Jessica Petereit

Carl-von-Ossietzky University Oldenburg

jessica.petereit@uol.de

In resource-constrained settings, providing quality education in subjects like chemistry, computer science, physics or biology can be challenging due to the

fundamental part of experimenting is hardly possible or even impossible (Jones et al., 2018; Roden et al., 2018). Our project addresses this gap through teacher education workshops designed to enhance education about sustainability while overcoming resource limitations. Participants can engage in hands-on experiments tailored for primary school children. Guided by scripted instructions, teachers execute experiments focused on fundamental concepts such as carbon dioxide, fire safety, or the properties of different aggregates, in the example of the chemistry topic. Following the workshops, online evaluations gauge participants feedback on content, structure, applicability, and comprehension. Our underlying goal is to raise awareness of sustainability issues, particularly within the framework of the Sustainable Development Goals (SDGs), while democratizing access to hands-on experiments (Amorós Molina et al., 2023). By equipping teachers with innovative and resource-conscious pedagogical tools, we aim to foster a deeper understanding of complex concepts and promote sustainable practices in classrooms worldwide. Preliminary results from 2023 in which we gave a three-day workshop in Capetown, Southafrica, indicate overwhelming satisfaction, with all expressing intent to recommend the workshops to colleagues. Notably, a majority reported feeling fully or partially equipped to incorporate workshop experiments into their teaching practice, which shows us that even with limited resources a very good practice of chemistry topics is able and wanted. From February until May 2024 we do online workshops with Pakistani teachers and gather more data on our chemistry workshops. This talk will be addressing

the preliminary results from our two workshops as well as future outlooks.

Keywords: Resource-Constrained Education, Sustainability, Hands-On Experiments, Teacher training, STEM

ABS-ICMSCE-24071

Total synthesis of cycloenegalinal A

Anderson Arnold Aloanis

Universitas Padjadjaran

andersonaloanis@unima.ac.id

Peptides are a new class of drugs that rarely induce the body's immune system. Cycloenegalinal A is a cycloheptapeptide compound isolated from the endemic Senegalese plant *Annona senegalensis*. Cycloenegalinal A is a peptide compound that has cytotoxic activity. To see further potential, it is necessary to completely synthesize the cycloenegalinal A compound. The synthesis is carried out in two phase, linear peptide synthesis conducted in solid phase and cyclization in conducted the solution phase. Solid phase linear peptide synthesis was carried out using the fmoc strategy and 2-chlorotriethylamine hydrochloride as the resin. To obtain optimal results, several C-terminal and N-terminal selections were made. For the cyclization process in the solution phase, several coupling reagents and several variations of conditions such as time and concentration are used to obtain optimal results. The most optimal results were obtained by using L-Ala as the N-

terminal and L-Ser as the C-terminal. In the cyclization process, the most optimal conditions are to use HATU/DIPEA reagent in dichloromethane solvent for 7x24 hours. The cycloenegalinal A compound was characterized using mass spectroscopy by calculating mass for C₂₈H₄₈O₉N₇ [M+H]⁺ m/z = 626.3514.

Keywords: Annona senegalensis, Solid phase peptide synthesis, solution phase peptide synthesis

ABS-ICMSCE-24073

Development of Chemical Teaching Materials on Alcohol Compounds with the Context of Making Bioethanol from Cassava Peels (Manihot esculenta) to Build Environmental Literacy

Ayu Ashari, Dr. Paed. Sjaeful Anwar, Dr. rer. nat. Omay Sumarna, M.Si

Universitas Pendidikan Indonesia
ayuashari.edu@gmail.com, sjaefulanwar20@gmail.com,
omaysumarna@upi.edu

Teaching materials are a component of the teaching and learning process that needs attention because there are still many teaching materials whose breadth and depth of materials do not meet curriculum demands and do not match student development. This research aims to produce chemical teaching materials regarding alcohol compounds in the context of making bioethanol from cassava peels using the 4STMD method to build environmental literacy. The research method uses

Developmental Research (DR) consists of design, development, and evaluation. The research participants were class XII students from a private high school in the city of Bandung. The research instruments are the optimization sheet, the four-stage 4STMD instrument, the feasibility instrument, and the understandability instrument. Stage development results design obtained a plan for the preparation of teaching materials; level expansion results development using the 4STMD method which consists of four stages, namely selection, structuring, characterization and didactic reduction. In the selection stage, 17 competency achievement indicators and 16 concept labels were obtained. Concept development using 17 international textbooks and 2 high school chemistry books. Environmental literacy as a pedagogical context and making bioethanol from cassava peel as a substance context. In the structuring stage, concept maps, macrostructure and three levels of representation are obtained. The concept map of the context of making bioethanol from cassava peel is part of the concept of making alcohol by biological means. In the characterization stage, 3 texts out of 36 texts were obtained which had to be reduced to didactics. Stage results evaluation, the results of the feasibility test for teaching materials were in the very appropriate category (98.28%) and the comprehensibility test was in the high category (87.05%), and had the potential to build environmental literacy. Thus, it can be concluded that teaching materials are suitable for use with high comprehensibility and can be used to build students' environmental literacy.

Keywords: Teaching Materials, Alcohol Compounds, Bioethanol, Environmental Literacy

ABS-ICMSCE-24093

**DEVELOPMENT OF RESEARCH ON
COMPUTATIONAL THINKING SKILLS IN
CHEMISTRY EDUCATION: A SYSTEMATIC
LITERATURE REVIEW**

Indah Langitasari, Ahmad Mudzakir, Elah Nurlaelah,
Sunyono, Asep Wahyu Nugraha
Universitas Pendidikan Indonesia
indahlangitasari@upi.edu

Computational Thinking Skills (CT Skills) are part of the 21st-century skills students must have as one of the keys to future success in the digital era. CT Skills has been widely applied in various fields, including chemistry education. This literature review aims to study research developments, benefits, opportunities, and challenges of using computational thinking skills in chemistry learning. Search results from the Scopus database with predetermined keywords yielded five suitable references. Next, a content analysis was conducted on the five references to see the opportunities and challenges of applying CT skills in chemistry classes. Based on a literature review, the development of research into the use of computational thinking skills in chemistry learning is still beginning to develop and has yet to be widely carried out. The use of CT skills in chemistry learning is still limited at the secondary school level and has yet to be

found to be used at the college. It opens up a great opportunity to research the use of CT skills, especially in college for prospective chemistry teacher students. However, several challenges need to be faced, including the readiness of teacher competencies, teaching materials, assessment instruments, and teachers' need for didactic preparation. Your role in addressing these challenges is crucial and valued.

Keywords: Computational thinking; CT skills; chemistry learning; challenges; systematic literature review

ABS-ICMSCE-24103

Enhancing Conceptual Understanding and Essential Learning Skills in Chemistry through Micro Project-Based Learning (MPBL) Model

Peiyao Tian, Daner Sun

Department of Mathematics and Information
Technology, The Education University of Hong Kong
pytian1997@gmail.com, dsun@eduhk.hk

Active engagement in project-based learning (PBL) has been recognized as a means to foster students' learning outcomes and higher-order thinking skills across various disciplines. However, the implementation of PBL in K-12 classrooms often encounters challenges, primarily due to the lengthy and structured PBL cycle. As an alternative approach, micro-project-based learning (MPBL) advocates for the principles and mechanisms of PBL while compressing the learning cycle into shorter periods.

This study aimed to investigate the impact of MPBL on students' conceptual understanding and their essential learning skills in chemistry classes at the upper secondary level. A single-group pretest-posttest research design was employed, involving 63 students who received the MPBL instruction. Data were collected and analyzed through knowledge tests, and surveys assessing essential learning skills. The findings revealed that after the intervention, students' conceptual understanding and essential learning skills significantly enhanced. This study provides valuable insights into pedagogical innovations in chemistry education and teaching practices within chemistry classrooms.

Keywords: Chemistry education; conceptual understanding; essential learning skills; MPBL model

ABS-ICMSCE-24113

**Problem-Based Learning: A Systematic Literature
Review of Chemistry Education Research in
Indonesia**

ELVA LAILA, FESTIYED, YERIMADESI

UNIVERSITAS NEGERI PADANG

elvalaila14@gmail.com, festiyed@fmipa.unp.ac.id,

yeri@fmipa.unp.ac.id

The research aims to conduct a systematic literature review of previous research on problem-based learning in the context of chemistry education in Indonesia. So it is hoped that you will get general information about the

findings and discussion trends. The research objectives were achieved using descriptive content analysis. The articles reviewed in the research were articles conducted in Indonesia between 2010 and April 2024. Publish or Perish 8 and Science Direct were used to access these articles. A sampling method based on purposive sampling was used in this research so that 112 Scopus-indexed studies from various regions in Indonesia were included. To facilitate data analysis, researchers developed coding for the articles reviewed. The results of this research show that the application of the problem-based learning model can have a positive impact on various student learning skills to support better student learning outcomes. The most widely used research design among all the studies reviewed is the quasi-experimental design.

Keywords: Problem-based learning; chemistry education; Indonesia

ABS-ICMSCE-24134
**Introducing Small-Scale Chemistry Laboratory on
The Topic Simple Water Treatment Process to
Support Sustainable Development Goals (SDGs)**

rika siti syaadah
Universitas Negeri Jakarta
derriikaa@gmail.com

Chemistry is subject that closely related both cognitive and practicum activity, because of it practicum is one thing that can't be separated from chemistry. In general, practicum in chemistry learning its hard to implement for several reason such as tools and chemicals limitation, expensiveness of chemicals and also waste that produce by practicum activity. Small-scale Chemistry laboratory is one solution to solve the problems has mentioned above. Lack of practicum in chemistry learning has an impact on student's cognitive and soft skill ability. This study aimed to introducing small-scale chemistry laboratory to support sustainable development goals (SDGs). This experiment used pre-experimental method. Based on the result of the research, 77,26% student's gave a positive response to implementation small-scale chemistry laboratory. Based on findings, it is recommended to applied small-scale chemistry laboratory on the other chemistry topics to enhance student's cognitive and soft skill ability and also to build sustainability awareness in real life.

Keywords: Small-scale chemistry laboratory, Water Treatment, Sustainable development goals, Green Chemistry

ABS-ICMSCE-24135
**Identifying Creativity in Organic Chemistry
Practicum: A Bibliometric Review**

Salastri Rohiat
Universitas Pendidikan Indonesia
salastri@unib.ac.id

The article "Identifying Creativity in Organic Chemistry Practicum: A Bibliometric Review" explores an unexplored area of scientific research regarding the development of student creativity in organic chemistry practicums. Through comprehensive bibliometric analysis, we aim to uncover current trends, identify key contributors, and evaluate interdisciplinary relationships in this growing field. This study seeks to assess the impact of developing student creativity in organic chemistry practicum, identify influential research and address existing gaps. By providing evidence-based insights, this analysis aims to guide educators, researchers and policy makers in shaping future trajectories for developing student creativity in chemistry practicum as an effort to support students' understanding in the study of organic chemistry in a comprehensive and constructive manner

Keywords: creativity, chemistry, organic, practicum, bibliometrics

ABS-ICMSCE-24140

**Meningkatkan Keterampilan Mengajar mahasiswa
Menggunakan Multy Strategies dan Pengembangan
Lesson Plan**

tuti kurniati, Yerimadesi, Festiyed
universitas muhammadiyah pontianak
kurniati_tuti@ymail.com, yeri@fmipa.unp.ac.id,
festiyed@fmipa.unp.ac.id

The purpose of this study was to improve student teaching skills using multiple strategies and lesson plan development in the chemistry education study program. The research method used was classroom action research conducted in two cycles. The research procedure in the form of Lesson Study activities are: (1) Plan (planning), (2) Do (implementation), and (3) See (reflection) which is integrated with the basic chemistry teaching skills course. The subjects of this study were chemistry students in the fourth semester of the chemical education study program at Pontianak Muhammadiyah University. Data collection used an observation sheet of the lesson plan made and the learning implementation process. Data analysis in this study was descriptive. The results of the research obtained are, 1) Planning based on 7 aspects assessed, obtained: (1) completeness of the identity of the lesson plan from 63.3% to 95, 2%, (2) formulation of learning objectives from 53.8% to 82.8%, (3) description of the subject matter from 55.6% to 87.2%, (4) methods, strategies and learning media from 52.2% to 94.6%, (5) design of learning steps from 67% to 90.8%, (6) assessment (cognitive, affective and psychomotor) from 53.4% to 76.8%, (7) learning resources from 66.8% to 88.2% . In stage 2)

Implementation based on the 3 aspects assessed, obtained : (1) Introduction 68.3 Good category to 88.7% Very Good category. (2) core 65% Fair category to 88.5% Very Good category and (3) closing 70% to 95% Very Good category. Based on the data obtained, it is known that the application of multiple strategies and lesson plan development in basic chemistry teaching skills courses can improve students' basic teaching skills.

Keywords: Teaching skills, Lesson Plan, Multy Strategies

ABS-ICMSCE-24147

Utilization of LMS in Secondary School Environment to Support Multirepresentation Chemistry Learning: Preliminary Research

Adinda Ajie, Dr. Wiji, M. Si., Dr. Sri Mulyani, M. Si.
Universitas Pendidikan Indonesia
adindamecea@gmail.com, maswiji@upi.edu,
srimulyani@upi.edu

In the industrial era 4.0, digital transformation has penetrated various aspects of life, education included. LMS stands as a crucial solution in adapting to this evolving landscape, providing streamlined and structured access to educational materials with greater ease and speed. Multiple representations to convey concepts in chemistry is a fundamental aspect of chemical education. Recognized as an effective pedagogical approach, employing various representations—macroscopic,

submicroscopic, and symbolic—facilitates a more profound understanding of complex chemical principles among students. This study aimed to explore the utilization of LMS in secondary school settings to bolster multi-representational approaches to teaching chemistry. Involving 45 secondary school chemistry educators located in the vicinity of Bandung and Cimahi, the research employed a survey methodology to gather insights into LMS usage and perceptions. The survey instrument, comprising both open-ended and closed-ended questions, was designed to categorize and analyze responses effectively. Findings revealed that a significant portion (76.6%) of secondary schools in the Bandung and Cimahi regions have embraced LMS as a cornerstone of online learning, with 32% among them possessing independent web domains. The versatility of LMS features facilitates adaptable learning environments, as highlighted by respondents. Given the advantages and functionalities of LMS, an overwhelming majority (91.1%) of participants affirmed its capacity to support the delivery of online multi-representational chemistry instruction. Thus, the survey outcomes underscore the pivotal role of LMS not only as a pertinent tool but also as an effective means of enhancing online chemistry education within secondary school contexts of multi-representational chemistry learning.

Keywords: Survey, LMS, Secondary School, Multirepresentation, Chemistry.

ABS-ICMSCE-24150
**RARE EARTH ELEMENTS RECOVERY FROM
RED MUD: A BIBLIOMETRIC ANALYSIS**

Lukman Hadi, Ahmad Mudzakir
Universitas Pendidikan Indonesia
lukman.hadi@upi.edu, mudzakir.kimia@upi.edu

Red mud or bauxite residue is an industrial waste generated during the processing of bauxite into alumina using the Bayer process. This Industrial waste is harmful to the environment but still contains beneficial elements. This study aims to provide a bibliometric analysis of rare earths recovery from red mud from 2004-2023. Data were extracted from the Scopus database and analyzed using VOSviewer. A total of 112 related publications were explored and mapped. According to bibliometric analysis, rare earth elements, red mud, and Scandium become research trends. It also shows that sustainability, acid leaching, magnetic separation, iron recovery, fly ash, e-waste, hydrometallurgy, sulfuric acid, scandium recovery, valorization, leachability, bioleaching, circular economy, and Taguchi method are among the novel and emerging topics in rare earth elements recovery from red mud. This research is expected to provide a better understanding of the challenges and opportunities of studying rare earth elements recovery from red mud.

Keywords: Bibliometric, Rare earth elements, Recovery, Red mud, Trends

ABS-ICMSCE-24157
**ANALYSIS OF STUDENTS' CHEMICAL
LITERACY THROUGH ETHNOCHEMICAL
LEARNING IN MATERIALS COLLIGATIVE
PROPERTIES OF SOLUTION**

Bibit Harianto
Universitas Pakuan
072623017@student.unpak.ac.id

Students' difficulties in studying chemistry are caused by several factors, including a lack of chemical literacy. This will have an impact on students' understanding and knowledge of chemistry. Chemical literacy is very important for students to have because it can improve their thinking processes and overcome current problems. This research aims to describe students' chemical literacy profiles in the Colligative Properties of Ethnochemically Loaded Solutions material. The research method used is descriptive with a quantitative approach. The subjects in this research were 22 class XII students at SMAN 1 Danau Seluluk. Data collection uses test and questionnaire methods. The instrument used was 10 essay questions. The research results show that students' chemical literacy in the content aspect is categorized as sufficient, while the context and competency aspects are categorized as insufficient. Efforts to overcome low chemical literacy can be done through learning with an ethnochemical approach, because the problems given are contextual in nature and close to the environment and students' experiences. The ethnochemical approach can be substituted in the learning process or through the development of online or offline learning media.

Keywords: Competency_Aspect; Context_aspect;
Content aspects; Ethnochemistry; Chemical_Literacy

ABS-ICMSCE-24158

**Development of E-Modules Oriented to Scientific
Literacy for High School Students**

Ester Purba, Hernani, Ali Kusrijadi

Universitas Pendidikan Indonesia

yuliati.ester@upi.edu, hernani@upi.edu,

ali_koes@upi.edu

The low scientific literacy skills of students in Indonesia are influenced by the lack of independent learning resources, curriculum demands, and the selection of inappropriate learning methods by educators. This encourages the development of e-modules oriented to science literacy on plastic waste that is validated and tested. The technique used was Design Development Research (DDR) (Richey & Klein, 2010) with stages: (1) planning, (2) development, and (3) evaluation. In the planning stage, learning objectives and content and context related to plastic waste were formulated, which became the basis for the next stage. The next stage, namely development, contains the formulation of an introductory text and an e-module outline that expert lecturers and chemistry subject teachers validate. The validation results showed e-modules with suggestions for improvement, such as sentence improvement, image clarity, and the use of affixes. The evaluation stage used a readability test and a student response questionnaire. This

readability test shows that the e-module is categorized as independent, meaning that students have no difficulty understanding it. Students' responses to the appearance, presentation, language, and context used in the e-module were good.

Keywords: scientific literacy, plastic waste, e-modules, DDR

ABS-ICMSCE-24166

Integrating Education for Sustainable Development through Chemistry E-module of Renewable Energy

Aldini Aulia, Hernani, Ali Kusrijadi

Universitas Pendidikan Indonesia

aldiniaulia1@upi.edu, hernani@upi.edu,

ali_koes@upi.edu

Education is key to advancing a society that can achieve the Sustainable Development Goals (SDGs), but the sustainability aspect has not been fully taught in chemistry learning. This study aims to develop an e-module-oriented education for sustainable development (ESD) on the topic of renewable energy. The research design used was education design research (Plomp, 2007), which consists of a preliminary research phase, development or prototyping phase, and assessment phase. The instruments used were an interview sheet, e-module construction format, e-module validation sheet, and readability test sheet. The result of this research shows that 1) Teachers don't know about ESD and how it relates to life, so it's

required to develop chemistry contents and contexts in e-module that link ESD with live. 2) The content of the developed e-module is biofuel as renewable energy by integrating the three pillars of ESD (environmental, social, and economic), which were validated by five validators. The validation results show that the e-module developed in general has fulfilled the criteria for e-module assessment with suggestions for improvement regarding the suitability of images, as well as sentence improvements, and has been fixed. 3) The results of the e-module readability test get a score of 79%, including in the 'independent' category, which means students have no difficulty in understanding the information contained in this e-module. This shows that e-module can be used in the process of learning chemistry in high school.

Keywords: E-Module, ESD, Renewable Energy, Chemistry Learning

ABS-ICMSCE-24213

The Evaluation of Physical Chemistry Laboratory Course Implementation

Ruqayyah -, Liliyasi, Hendrawan, Budiman Anwar
Universitas Pendidikan Indonesia
ruqayyahzkuddah@gmail.com, liliyasi@upi.edu,
hendrawan@upi.edu, budimananwar@upi.edu

The purpose of this research is to evaluate the implementation of the physical chemistry laboratory course and to develop programs to address existing gaps.

The research method used in this study is a qualitative approach with a naturalistic research design. The sample consisted of 32 students of third-semester chemistry education enrolled in a physical chemistry laboratory course at a university in Bandung, Indonesia. This study collected data using observation, interviews and documents analysis techniques and the data were analyzed qualitatively. This research found that the implementation of the physical chemistry laboratory course had several gaps, such as a lack of students' understanding and ability to associate concepts with context, insufficient student comprehension of experimental procedures, and inadequate training in using mathematical concepts to derive physical chemistry formulas. These several gaps possibly caused by the experimental procedures, which are still in a cookbook style. Students do not take initiatives to determine the experimental steps and basic ideas. This finding confirms what has already been reported in previous studies. To fill these gaps, the researchers suggest applying inquiry-based laboratory methods. Previous research suggests that these approaches are useful in bridging the gaps in physical chemistry laboratory courses.

Keywords: Course implementation evaluation, laboratory course, physical chemistry laboratory.

ABS-ICMSCE-24215

Applying the Logistic Function of the Temperature Changes in Aqueous Glucose Modeling

Deklin Frantius, Liliasari, Edy Soewono, Asep Bayu
Dani Nandiyanto

Universitas Pendidikan Indonesia
deklinfrantius@upi.edu, liliasari@upi.edu,
esoewono@math.itb.ac.id, nandiyanto@upi.edu

This study employs the logistic function to model the thermal dynamics of glucose solutions. Combining experimental measurements and theoretical modeling, the research tracks temperature changes in glucose solutions of varying concentrations using a digital thermometer. The logistic function is utilized to model the rate of temperature rise, considering factors such as initial temperature, boiling point, and glucose concentration. The model effectively predicts the temperature increase, showing an initial rapid rise that slows as the solution approaches equilibrium. The rate of temperature increase (r) was determined for different glucose concentrations, exhibiting a linear relationship. The proposed model for the temperature as a function of time is $T(t) = T_b / (1 + e^{-(0.128 + 0.052C)t})$, where T_b is the boiling point, T_0 is the initial temperature, and C is the glucose concentration (%). Statistical validation showed high accuracy, with mean squared error (MSE) ranging from 0.0076 to 0.051, root mean squared error (RMSE) from 0.087 to 0.227, and R^2 values consistently near 0.999. Kruskal Wallis tests confirmed no significant differences in heat source consistency (Asymp. Sig. 0.999), while Mann Whitney tests showed no significant differences

between predicted and experimental temperatures ($p > 0.05$). Residual analysis indicated a normal distribution with mean residuals close to zero, demonstrating the model's robustness. Minor deviations were observed at higher glucose concentrations. This research provides valuable insights for optimizing heating processes in various applications and enhancing process control and efficiency in relevant industries.

Keywords: logistic function, modeling, aqueous glucose

ABS-ICMSCE-24225
Development of e-Module Assisted by Advance Organizer Integrated with Local Wisdom to Practice Critical Thinking Skills
Try Hartiningsih, Yamin
Universitas Trunojoyo Madura
try.hartiningsih@trunojoyo.ac.id,
yamin@trunojoyo.ac.id

Chemistry developed from the discoveries of chemists were expressed in scientific methods like concepts, laws and principles. In chemistry learning, students are not only given concepts but carry out processes so that they have skills. The results of observation at one of senior high school give information that the learning resources used a module from the city government which very limited in content and did not build students' critical thinking skills. In accordance with the characteristics of student-centered learning, it is necessary to develop e-

module that are assisted by advanced organizer and integrated with local wisdom. The aims of developing is producing e-module for senior high school chemistry class with the topic of buffer solutions assisted by an advanced organizer integrated with local wisdom. The development model used refers to ADDIE. This model consists of five stages. There are analysis, design, develop, implementation, and evaluation. The data obtained from the validation results are in the form of qualitative data and quantitative data which are analyzed according to the characteristics of the e-module components. The result of development product is e-module for chemistry class XI with the subject of buffer solutions assisted by advanced organizer integrated with local wisdom. The validation results show that average percentage of 82.45%, that mean this module is good for use as a learning resource in teaching buffer solution material assisted by advanced organizer integrated with local wisdom.

Keywords: Advance organizer; critical thinking skills; e-module; local wisdom

ABS-ICMSCE-24239
**EVALUATION OF THE IMPLEMENTATION OF
BIOCHEMISTRY LECTURES DURING THE
COVID-19 PANDEMIC**

Gun Gun Gumilar, Nahadi, Asep Kadarohman, F. M.

Titin Supriyanti

Universitas Pendidikan Indonesia

gumilarchemi@upi.edu, nahadi@upi.edu,

kadar@upi.edu, fm.titin@upi.edu

The COVID-19 pandemic, which has been going on for more than two years, has had a serious impact on several fields, including education. One of the impacts on the education sector is adjustments to the implementation of learning. Learning that is usually done offline has changed to online learning. In this research, an evaluation was carried out on the implementation of lectures in four courses in the biochemistry group during the Covid-19 pandemic. This research uses a descriptive case study design. Research data was obtained from document analysis, questionnaires and interviews. Questionnaires were given to 155 students, while interviews were conducted with 2 lecturers. The results of the research show that the implementation of lectures in the four courses in the biochemistry group has been carried out well. This is shown by the positive responses from students obtained through questionnaires. However, there are slight differences in student learning outcomes compared to pre-pandemic conditions. But of course this needs to be investigated further.

Keywords: COVID-19 pandemic, Online learning, Biochemistry lectures, Case study

ABS-ICMSCE-24240
**DEVELOPMENT OF FLIPBOOK MEDIA
INTEGRATED SETS AND ITS INFLUENCE ON
STUDENTS' ENVIRONMENTAL LITERACY ON
THE SUBJECT OF PETROLEUM AND
ALTERNATIVE ENERGY**

Faa'izah Abiyyah Rihhadatul'aysi, Agung Purwanto, Ucu Cahyana
Jakarta State University
aisyfaizah@gmail.com

Education is entering the era of society 5.0 which comes with applications in artificial intelligence or artificial intelligence in digital media in learning activities. This research aims to develop an integrated SETS flipbook on Petroleum and Alternative Energy material and its influence on students' environmental literacy. The Borg and Gall research and development method was used by modifying ten stages, with environmental literacy test instruments and questionnaires, validation by media experts, language experts and material experts with percentage results of 73.00% to 95.00%. The research carried out field trials in the form of student and teacher trials, instrument feasibility and implementation tests with a percentage of 86.30% to 91.67% getting good interpretations. Environmental literacy instruments and implementation are effective in that the use of flipbooks

can provide positive results on environmental literacy with an increase based on independent T-test hypothesis testing and the results obtained are $T_{\text{count}} > T_{\text{table}}$ so that H_0 is rejected and H_1 is accepted. This research can be concluded that the SETS integrated flipbook on the subject of Petroleum and Alternative Energy is suitable for use and suits the needs of students and teachers and has a positive effect on environmental literacy.

Keywords: flipbook, SETS, Petroleum and Alternative Energy, environmental literacy

ABS-ICMSCE-24246

**Comprehensive Review of 2,4,6-Triaryl Pyridine:
Modern Synthetic Approaches and Potential
Applications in Materials and Pharmaceutical
Chemistry**

Arfiani Nur

Hasanuddin University

arfianinur@gmail.com

The synthesis of 2,4,6-triarylpyridines is of significant interest due to their diverse applications in pharmaceuticals, advanced materials, and catalysis. This review highlights recent advancements in both conventional and green synthesis methods, including the use of homogeneous and heterogeneous catalysts, eco-friendly solvents, and alternative energy sources such as microwave and ultrasonic irradiation. The efficiency, selectivity, and environmental impact of these methods

are critically evaluated. Additionally, the review delves into the reaction mechanisms and thermodynamics of these processes. Practical applications and economic benefits are also discussed, providing a comprehensive overview and future research directions for developing more sustainable and efficient synthesis strategies

Keywords: synthesis, 2,4,6-triarylpyridine, catalysts, eco-friendly solvents, materials

ABS-ICMSCE-24250

Use of laboratory instruction on the topic of liquid-liquid ternary phase diagrams: A Literature Review

Alfred tobok, ijang rohman, Liliasari
universitas pendidikan indonesia
alfred.siahaan@upi.edu, ijangrh@upi.edu,
liliasari@upi.edu

Laboratory instruction plays a crucial role in physical chemistry education by providing essential practical experience for understanding theoretical concepts. This study aims to analyze the limitations of laboratory instruction on the topic of liquid-liquid ternary systems in physical chemistry courses and to identify factors affecting the effectiveness of teaching this topic in the laboratory. The methodology used in this research is a literature review of journal articles published in the last 10 years. Relevant articles were collected from scientific databases such as Scopus, Web of Science, and Google Scholar using keywords "liquid-liquid ternary systems,"


"laboratory instruction," and "physical chemistry." The selected articles were then analyzed to address the research questions. The results indicate that the main limitations include insufficient laboratory resources and equipment, insufficiently detailed laboratory instructions, and inadequate time allocation for experiments. Additionally, teaching modules and materials are often not comprehensive. Factors affecting the effectiveness of learning include the quality of instructor training, the use of technology in teaching, interactive and structured teaching approaches, additional academic support and learning resources, and collaboration and group discussions. To overcome these limitations and enhance the effectiveness of teaching liquid-liquid ternary systems in physical chemistry courses, improvements are needed in several areas. These include providing adequate resources and equipment, better instructor training, utilizing technology in teaching, adopting interactive teaching approaches, and providing additional academic support. Implementing these changes is expected to help students understand and master the concepts and practical applications of liquid-liquid ternary systems more effectively.

Keywords: Laboratory instruction, liquid-liquid ternary systems, A Literature Review

ABS-ICMSCE-24259
**Designing Science Learning with ESD Content Using
Lerak Plants In Biotechnology Material**

Nengsih Kumala Sari, Leny Heliawati
SMP AL MINHAJ TAMANSARI
nengsihkumalasari@gmail.com,
lenyheliawati@unpak.ac.id

In the Islamic boarding school environment, learning focuses more on religious learning skills (diniyyah), so students are less interested in learning general material including natural sciences (IPA). This situation is a challenge for teachers to design learning innovations using school detergent waste as a learning resource. The integration between the concept of Education for Sustainable Development (ESD) and chemistry is carried out with the aim of developing students' thinking patterns to support sustainable development by fostering sustainability awareness in students. Especially SDG's goal point 6 is access to clean water and adequate sanitation. The results of the literature study also show that there is not much research on sciencepreneurship. Another aim of this research is to design project-based science learning innovations (PjBL) oriented towards improving life skills in junior high school level biotechnology material. The product produced is a natural detergent using natural ingredients in the form of lerak plants so it has economic value for training students' sciencepreneurship. It is hoped that the research results can be a solution to the problem of water pollution in the school environment to support SDG development goals.



This research method is quasi-experimental using a pretest-posttest control group design.

Keywords: Sustainability Awareness, ESD, SDGs, Sainspreneurship, Lerak plants



ABS-ICMSCE-24004

The Didactic of Vector Space: A Systematic Review between Diffusion and Acquisition Issues

Enjun Junaeti, Dadang Juandi, Lala Septem Riza

Universitas Pendidikan Indonesia

enjun@upi.edu, dadang.juandi@upi.edu,

lala.s.riza@upi.edu

The aim of this systematic review is to uncover the findings of didactic research pertaining to Vector Space. While previous studies have explored instructional practices, there remains a limited understanding of how these collective research findings contribute to our knowledge of the diffusion and acquisition issues. In this systematic review, the didactic on material of Vector Space is categorized into two primary sections: 1) the methods employed in diffusing knowledge and skills, and 2) the process and outcomes of knowledge acquisition. By incorporating graphs and flow maps, the presentation of data becomes more intuitive and comprehensible. Furthermore, the review addresses both existing and potential obstacles to learning. Ultimately, it is anticipated that this research will serve as a valuable resource for knowledge diffusion practitioners and researchers seeking to advance the field of didactics in the context of vector spaces.

Keywords: Vector Space, didactic, systematic review, diffusion, acquisition

ABS-ICMSCE-24007
**Development of PISA Type AKM Questions Using
the Context of Muara Enim Batik Based on PMRI
and PJBL**

Arbella Sri Marleny. M
Universitas Sriwijaya
arbella.unsri@gmail.com

This research aims to produce PISA type AKM questions for elementary school students using the PMRI and PJBL-based Muara Enim Batik context that are valid, practical and have potential effects. The research method used is design research, development study type. Data analysis is descriptive analysis. The results of the research are a set of PISA type AKM questions using a valid, practical and potential effect context with 4 questions. Valid in terms of content, construct and language based on validator assessments, practical based on small group trials and has potential effects based on analysis of student answers and questionnaire results in field tests. Based on the results of the analysis, it was found that the questions developed had several potential effects, namely involving the involvement of various basic mathematical abilities in the solution process. Apart from that, it is also able to attract interest and motivate students so that they are challenged to solve the questions. These questions also provide a stimulus for students to think critically using their own reasoning in solving them.

Keywords: Keywords: Design Research, Development Study, AKM, PISA, PMRI, PJBL.

ABS-ICMSCE-24019
**Unveiling Pedagogical Genius: Unraveling
Challenges of Developing Numerical Literacy
Problems Akin to AKM Standards**

Nusrotul Bariyah, Jarnawi Afgani Dahlan, Suhendra
Universitas Pendidikan Indonesia
nusrotulbariyah@upi.edu, jarnawi@upi.edu,
suhendra@upi.edu

The teacher's ability to create engaging numeracy problems is crucial for ensuring that students develop a strong grasp of numeracy. This study examines the suitability of AKM-type numeracy problems, which are compiled by teachers, with predetermined standards. The research was conducted using qualitative methods, with data collected through documentation of question preparation exercises by 61 junior high school mathematics teachers in two districts of West Java Province. Data analysis involved data reduction, presentation, and verification through triangulation by validator 1 and validator 2. The results were confirmed through question trials with students and student interviews. According to the findings, the teacher's stimulus included ineffective sentences and lacked contextual data. Additionally, the questions did not utilize visual aids such as charts, graphs, tables, or diagrams. The sequence of the questions was ambiguous and open to multiple interpretations. Lastly, the third question did not align with the cognitive level L3.

Keywords: AKM, cognitive level, numerical literacy, numeracy problem, problem analysis

ABS-ICMSCE-24020
**PROSPECTIVE TEACHERS' MATHEMATICS
LITERACY IN SOLVING BASIC
COMBINATORIC PROBLEMS REVIEWED
FROM COGNITIVE STYLE**

Novia Dwi Rahmawati
Universitas Negeri Semarang
noviadwirahmawati@students.unnes.ac.id

This research aims to describe the mathematical literacy of prospective teachers in solving basic combinatorics problems (counting rules, permutations and combinations) in terms of cognitive style. This type of research is qualitative research with a descriptive approach with a phenomenological research design. The subjects of this research are prospective 5th semester teachers based on reflective and impulsive cognitive styles. The research instruments used were tests and interviews. Data analysis techniques consist of data reduction, data categorization, data presentation and drawing conclusions. Results Research shows that prospective teachers' mathematical literacy with a reflective style in solving basic combinatorics problems is good at communication, mathematics, reasoning and argumentation, designing strategies to solve problems, using symbolic, formal, technical and operational language, and using mathematical tools, not yet able to present problems. in various forms of representation, linking

various mathematical concepts in the form of combinatorics, requiring many strategies and stages of completion. Meanwhile, the mathematics literacy of prospective teachers with an impulsive style in solving basic combinatorics problems in posing problems can still be said to be not good, because it only meets a few indicators, the problems posed still contain little information so they do not require many stages and strategies, the problems posed are more informative in nature. story form, not yet able to present problems in various forms of representation and not using mathematical tool.

Keywords: Mathematical Literacy, Basic Combinatorics, Cognitive Style

ABS-ICMSCE-24027

**Conceptions of Statistics of Indonesian Pre-Service
Mathematics Teachers and its Relations to Their
Statistical Cognitions**

Khairiani Idris, Nurul Akmal

IAIN Lhokseumawe

khairiani@iainlhokseumawe.ac.id,

nurulakmal@iainlhokseumawe.ac.id

Students enter statistics classes by bringing their conceptions and beliefs about statistics based on their personal experiences, understanding, and cultures. Their

conceptions of statistics may contribute to the approaches students used in learning statistics. This survey study described Indonesian pre-service teachers' conceptions of statistics and its relation to their statistical cognitions. 263 mathematics pre-service teachers from 3 Islamic Universities and 2 Public Universities from Aceh province and East Java Province were involved as study participants. Data were collected by using a questionnaire assessing students' conceptions of statistics and an instrument assessing their statistical cognitions. Data were analyzed quantitatively using descriptive statistical analyses to show distributions of the conceptions of statistics' categories. The relationship between conceptions' categories and statistical cognitions categories was analyzed using Kendall Rank-Order Correlation. The results showed that most students (45%) viewed statistics as Technique, about 25% of them viewed the subject as Pure Methodology, only 9.9% viewed it as Methodology in Context, and the rests could not be assigned in the three. Furthermore, more percentages of students from Islamic Universities were found in the Technique and Pure Methodology Categories, while more students from Public Universities were in the Methodology in Context category. A weak and insignificant correlation coefficient was found between the two variables ($\delta=.053$, $p = .338$) which means that the conceptions of statistics of students in this study did not statistically correlate with their statistical cognitions.

Keywords: conceptions of statistics, pre-service teachers, statistical cognitions, statistics learning

ABS-ICMSCE-24033

High school mathematics teachers' achievement emotions: Impacts on engagement and productivity in online and face-to-face professional development

Haidee Rosete, Sally B. Gutierrez

University of the Philippines National Institute for
Science and Mathematics Education Development
hprosete@up.edu.ph, sbgutierrezupd@snu.ac.kr

This study investigates the emotional experiences of high school mathematics teachers during both online course delivery and face-to-face lesson implementation courses of their professional development (PD). Guided by the control value theory of achievement emotions, we conducted an inductive analysis of the different data forms such as teachers' written and oral reflections and emotion surveys to explore the range and intensity of emotions experienced by 26 teachers. Data were iteratively coded and recoded to formulate themes that show the roles played by the achievement emotions of the mathematics teachers in their PD engagement and productivity. Findings reveal a diverse array of emotions reported by teachers, including excitement, frustration, satisfaction, and anxiety, depending on the instructional mode and situational factors. Moreover, teachers' appraisals of their ability to control and derive value from their PD significantly impacted their emotional responses, with those perceiving higher levels of control and value reporting greater engagement and productivity. The study highlights the complex interplay between emotions, perceptions of PD, and instructional practices, emphasizing the importance of supporting teachers' sense

of autonomy and professional efficacy in enhancing their emotional well-being and effectiveness in the classroom. These findings have implications in the design and implementation of PD that is focused on developing the teachers' pedagogical content knowledge to include their emotional aspects.

Keywords: teacher achievement emotions, control-value theory, mathematics education, professional development

ABS-ICMSCE-24043

Levels of Critical Thinking Ability: Field Dependent Students in Integral Calculus Learning

Rezi Ariawan

Universitas Negeri Semarang

reziariawan@students.unnes.ac.id

This study aims to identify the level of mathematical critical thinking ability of students with Field Dependent cognitive style in learning integral calculus. Qualitative research with a case study design used with the subject is a 3rd semester student of Mathematics Education at Riau Islamic University in the academic year 2023/2024 totaling 16 people. Data acquisition was done through data triangulation with test techniques using instrument mathematical critical thinking ability test questions and GEFT sheets for cognitive styles, non-test techniques using unstructured interview sheets. Data analysis using Miles Huberman technique which includes data reduction, data presentation and conclusion drawing.

Based on the results of data analysis obtained information that: There are field dependent students who are on LCTA-2 or critical LCTA. Most of the field dependent students are on LCTA - 0 or not critical in learning integral calculus. There are students with LCTA - 0 who have not been able to identify correctly, but the majority have been able to identify the information given correctly. Students with LCTA-1 or less critical are characterized by being able to identify correctly, state what is known, but have not been able to justify the plan of the solution. Students with LCTA-2 or critical have been able to state the concepts used to solve the problem, but have not been able to provide reasons for the solution.

Keywords: Level, Critical Thinking Ability, Field Dependent, Integral Calculus Learning.

ABS-ICMSCE-24048

A systematic literatur review: Mathematical critical thinking skills in the project based learning (PJBL) model from 2019-2023

ardon jamdin

Universitas Negeri Semarang

ardonjamdin80@students.unnes.ac.id

The mathematical critical thinking process is an important skill in 21st century learning. This study explores the potential of Project-Based Learning (PJBL) to improve critical mathematical thinking skills, and analyzes the challenges that may hinder its implementation. This

article aims to explain research findings that have been tested and published in Scopus journal articles over the last 4 years (2019 – 2023). In this systematic literature review (SLR), we analyzed 103 relevant publications (out of 136 initially identified) regarding mathematical critical thinking processes using PJBL in mathematics learning that met certain criteria. This research uses the PRISMA method, which consists of four parts (identification, screening, eligibility, and inclusion). Based on the SLR results, research on the PJBL model and mathematical critical thinking processes will mostly be carried out in 2023 in America and Indonesia. By identifying trends and keywords from existing literature, this study provides an understanding of the potential of PJBL to improve students' mathematical critical thinking skills in applying them in everyday life.

Keywords: Critical Thinking, Mathematics, PJBL

ABS-ICMSCE-24051

**Mathematical Literacy in The PISA Framework: A
Systematic Literature Review**

Idris Iskandar, Dadang Juandi, Wahyudin

Universitas Pendidikan Indonesia

idrisiskandar@upi.edu, dadang.juandi@upi.edu,

wahyudin.mat@upi.edu

The objective of this study is to describe the research findings on mathematical literacy in the PISA framework. The methodology employed in this study is the Systematic

Literature Review (SLR). A total of 12 studies examining mathematical literacy in the PISA framework were included in the sample, spanning the years 2005 to 2023. The study's findings were evaluated according to the publication medium, publication trends time by time, study level, research location, and research method on mathematical literacy in the PISA framework. Employing the Systematic Literature Review (SLR) approach with a Scopus database, the study revealed that the research published in Scopus Q2 had the highest number of published studies in the international journals, with the highest level of education being conducted at the junior high school level and publication time mostly on 2023. The majority of these studies were conducted in Indonesia and the methods of mathematical literacy research in the PISA framework primarily focused on four research methods: quantitative, qualitative, mixed method, and R & D. The study revealed that the quantitative method was presented in 50% studies, the qualitative method was presented in 8% studies, the mixed method was presented in 8% studies, and the R & D method was presented in 34% studies.

Keywords: Mathematical Literacy, PISA, Systematic Literature Review

ABS-ICMSCE-24052

Understanding Students' Ontogenic Obstacles in Learning Geometry: Identifying the Psychological, Instrumental, and Conceptual Obstacles

Tri Nova Hasti Yuniarta, Didi Suryadi, Yulia Nursari
Universitas Pendidikan Indonesia
trinova.yuniarta@upi.edu, dsuryadi1@gmail.com,
yulianursari17@guru.smp.belajar.id

This study investigates the ontogenic obstacles experienced by junior high school students during the process of learning geometry. The research aims to identify three types of ontogenic learning obstacles found in the geometry learning process: psychological, instrumental, and conceptual obstacles, to provide important insights to improve the quality of learning. Adopting a descriptive qualitative methodological approach, the study involved three observed classes totaling 96 junior high school students in Bandung. Data were collected through observation, interviews, and documentation, with ten students participating in the interviews. The findings offer a comprehensive overview of students' ontogenic obstacles encountered during geometry lessons in the classroom. One noteworthy observation is that students primarily encounter psychological ontogenic learning obstacles, exemplified by their lack of motivation and readiness concerning their interest in mathematics materials, particularly in geometry. Moreover, instrumental and conceptual ontogenic obstacles are also discernible in the research findings. Upon deliberating on the prevailing ontogenic

obstacles, this offers an opportunity for teachers to address these impediments to learning.

Keywords: ontogenic obstacle, learning geometry, psychological, instrumental, conceptual.

ABS-ICMSCE-24077

**Rethinking Kerawang Gayo as Cultural Identity in
Geometry Concept**

Rahmy Zulmaulida, Dr. Edy Saputra, M.Pd
IAIN Lhokseumawe
rahmyzulmaulida@gmail.com,
edysaputra.esa@gmail.com

This study aims to examine Kerawang Gayo as one of the cultural heritages formed by the geometry concept, meaning that the research used is a qualitative research method with ethnographic design. The research was conducted in Central Aceh Regency, Aceh Province, Indonesia. The subjects of the research were: 1) gayo traditional figures; 2) gayo traditional assembly; 3) gayo traditional museum; and 4) Central Aceh Regency Library. The method of determining the subject of the study is purposeful sampling. The data collection technique carried out by the researcher is the main instrument in this study, or key instrument, which must be integrated with the data source. Data analysis in this study is done through several processes, namely: a) data collection; b) reduction; c) presentation of data; and d) drawing conclusions. The results of the research obtained

are: a) There are 14 motifs found in Kerawang Gayo carvings; b) The motifs are Upuh Ulen-ulen, Pucuk rebung, Mata Itik, Leladu, Tulen Iken, Sesirung, Emun Beriring, Puter Tali, Gegaping, Bunge Kipes, Panah, Peger, Tlapak Sleman, and Rante; c) The motif meets several shapes and geometric elements, including translation, rotation, dilatation, reflection, and reflection; then some shapes in the geometry section, such as rectangles, rhombuses, circles, triangles, ellipses, and straight lines.

Keywords: Kerawang Gayo, Gayo Culture, Mathematics, Geometry, Etnomathematic

ABS-ICMSCE-24089

Investigating Algebraic Equation Problem-Solving Difficulties Among Junior High School Students in Ghana

Seth Junior Nti, Al Jupri

Universitas Pendidikan Indonesia

seth.nti@upi.edu, aljupri@upi.edu

Algebra is an important aspect that serves as a foundation for success in junior high school algebraic subjects, such as equations and functions. To navigate the complexities associated with fundamental algebraic operations, students must actively confront the problems they experience. The current study uses qualitative analysis to gain insights into the difficulties that Ghanaian students have with algebraic operations at the junior secondary

school level. We used a purposive sampling technique to collect data from 10 participants, including six (6) males and four (4) female students. We collected data through interviews and worksheets. We tested all participants, aged 14–16, on algebraic operations. We evaluated their work by identifying the challenges the students faced while factoring and simplifying algebraic expressions. The results showed that students have a hard time picturing algebraic forms and using the distributive and associative properties of algebraic expressions when they factorize or solve algebraic equations. This finding implies that understanding fundamental algebraic operations is important. We recommend that teachers investigate the difficulties students encounter in algebraic operations and devise instructional scaffolding approaches and teaching methods that assist students in overcoming specific learning barriers.

Keywords: Student's difficulty; Algebraic Operation; Equations; Problem-Solving; Ghana

ABS-ICMSCE-24090

Analysis of Student Numeracy in Solving Word Problems on Social Arithmetic Material

Epran, Yaya Sukjaya Kusumah

Universitas Pendidikan Indonesia

epranabdullah@upi.edu, yskusumah@upi.edu

This study aims to determine students' numeracy in solving word problems on social arithmetic material. This

type of research uses a qualitative approach with descriptive methods to describe student numeracy in solving word problems on social arithmetic material. The subjects of this research were seventh-grade students in one of the schools in Bengkulu City. The data collection techniques used in this study were tests, interviews, and documentation. The test instrument used was a word problem on social arithmetic material consisting of 3 items. The results showed that students' numeracy in solving word problems on social arithmetic material was good, with an average student numeracy score of 7.50.

Keywords: Analysis, Numeracy, Word Problems

ABS-ICMSCE-24108

A Systematic Literature Review: Generalization in Solving Number Pattern Problems

Nyla Farhatul Maula, Didi Suryadi

Universitas Pendidikan Indonesia

nylafhrhtl@gmail.com, ddsuryadi1@gmail.com

Generalization is a process of recognizing several general characteristics in a collection of mental objects to find similarities or patterns in each case so that general regularities can be applied. Generalization plays an important role in mathematics because it is considered inherent in mathematical thinking in general. Generalization is related to number patterns because number patterns can naturally lead to general expressions in generalizations. This research aims to analyze studies

related to generalizations in number pattern material from 2004 - 2024. The research method uses a Systematic Literature Review which collects primary data that has been published in Sinta and Scopus-indexed journals. Data extraction is adjusted to the selection criteria so that 18 articles are collected. Data analysis uses a qualitative approach. Data grouping was carried out based on year of publication, level of education, research subject, journal index, demographics, methods, and generalization topics analyzed. The results of the research show that studies related to generalizations in solving number pattern problems in 2015 and 2023 are the development period for the publication of articles related to this topic in reputable international and national journals. Researchers are more interested in researching generalizations in solving number pattern problems with the subject of students at the junior high school level. Most research on generalization in number pattern material applies qualitative methods and describes generalization strategies, generalization representations, and generalization processes.

Keywords: Generalization; Number Pattern; Systematic Literature Review; Mathematics; Education

ABS-ICMSCE-24121

**How Exponential Function are Studied: A
Praxeological Analysis of an Indonesian Textbook**
Ni Komang Savitri Dharma Suarka, Prof. H. Yaya S.
Kusumah, M.Sc., Ph.D.

Universitas Pendidikan Indonesia
savitridtharmasuarka9@upi.edu, yskusumah@upi.edu

Multiplying repeated numbers yields an expression for exponent numbers. Numerous studies have shown that students still experience difficulties when learning exponents. A particular approach to assist students in overcoming their challenges is using textbooks as a study resource. This study aims to evaluate the material provided in the Indonesian mathematics textbook about exponent and exponential function subjects. This study employed a qualitative research design utilizing a content analysis approach, using a mathematics textbook for observation and documentation. There were two primary stages to the analytical process: the logos bloc analysis and the praxis bloc analysis. The results showed that the Indonesian textbook organizes exponent into two distinct local definitions of function: repeated multiplication and exponential function. There are four different kinds of tasks based on the praxis block. The definition of an exponent, the characteristics of the exponent, the exponential function, and the graphic of the exponential function. Even though there aren't many differences between formal definitions and book definitions of exponential and exponential functions, textbook tasks tend to be repetitive, so it's important to include assignments that encourage students to think more critically and creatively.

Keywords: textbooks, praxeology organization, exponent, exponential function

ABS-ICMSCE-24126
**Thinking Styles in Mathematics Learning: A
Systematic Review between 2019-2023**

Beni Junedi
Universitas Negeri Semarang
benijunedi@students.unnes.ac.id

Thinking style is a process that involves the brain in obtaining information and processing that information to solve problems according to its abilities. Thinking style is important to pay attention to because it involves psychological aspects that encourage mental activity so that it supports students in determining their success. The research aims to examine research trends, effect sizes and theoretical frameworks regarding mathematical thinking styles in calculus lectures which are reviewed from research from 2019 to 2023. The type of research used is a systematic review by analyzing articles from the title, abstract and content analysis process of the article. . From the selection process, 24 articles were obtained which will be reviewed. From the articles reviewed, it is concluded that research trends in mathematical thinking styles are more connected with other mathematical thinking abilities, while research into mathematical thinking styles consists of qualitative, quantitative and mixed research, the theoretical framework found is in the form of definitions of mathematical thinking styles, groupings of mathematical thinking styles. and implementation of mathematical thinking styles in mathematics learning

Keywords: Thinking Style, Mathematics, Systematic review

ABS-ICMSCE-24130
**Various Vaccination Strategies to Tackle The
Pandemic Of An Infectious Disease**

Benny Yong

Department of Mathematics, Parahyangan Catholic
University

benny_y@unpar.ac.id

At the end of 2023, there was an increase in positive COVID-19 cases in Indonesia. During the period from November 28, 2023, to December 2, 2023, weekly cases reached 267 patients. One of the factors contributing to this rise is the presence of a new variant that makes the transmission rate faster and more easily spread. Based on vaccination data from the Ministry of Health on December 12, 2023, out of a vaccination target of 234,666,020 people, 86 per 100 target residents have received at least one dose of the vaccine. Although the vaccination campaign has been ongoing for a long time and many residents have received the vaccine, the rate of COVID-19 spread remains high, especially when community mobility increases. This research will provide an overview of the dynamics of COVID-19 spread in Indonesia through mathematical models that consider various vaccination strategies. The three vaccination strategies to be used are constant vaccination, periodic vaccination, and pulse vaccination. The constant vaccination strategy provides continuous protection against infectious diseases by continuously increasing population immunity. The periodic vaccination strategy updates immunity at certain intervals required to maintain optimal immunity levels. The pulse vaccination strategy

provides rapid protection to vulnerable populations during outbreaks or spikes in cases. The research results are expected to address issues regarding which vaccination schedule and strategy are most effective in tackling the spread of COVID-19.

Keywords: COVID-19; vaccination; constant vaccination; periodic vaccination; pulse vaccination.

ABS-ICMSCE-24132

The Properties of W-Concave Function on Convex Metric Space

Rahmanda Amrullah, Encum Sumiaty

Universitas Pendidikan Indonesia

rahmandaamrullah.1103@upi.edu, esumiaty@upi.edu

Studies on convexity are always interesting to do. It starts from a convex set until other results are found, such as convex functions, concave functions, convex metric spaces, convex linear normed space, and W-convex function. However, there is still another topic that has not been studied, namely W-concave function on convex metric spaces. Therefore, this research examines the W-concave function and its properties. The method used is adapting and modify the definition of concave and W-convex functions also the properties of W-convex function. The W-concave function can be viewed as a generalized of ordinary concave function on normed linear space. Then, the properties of W-concave function

are similar to W -convex function, but the forms and conditions used are different.

Keywords: W -convex function, W -concave function, and convex metric space

ABS-ICMSCE-24142

**Empirical Research on Computational Thinking in
Mathematics Learning: A Systematic Literature
Review**

Budi Rianto, Kusnandi, Al Jupri
Universitas Pendidikan Indonesia
budi88rianto@upi.edu, ,

This literature review aims to review empirical studies of Computational thinking (CT) in mathematics instruction. The review included reports on the purpose, targeted population, scope of materials, and CT components used. The methods used in conducting and reporting a systematic literature review include planning, conducting, and reporting the review. Based on the results of the analysis of 13 articles from the SINTA database, it is known that the objectives of the research conducted include developing instruction tools related to CT, analyzing student CT, examining the use of software or applications in CT development, exploring CT in instruction, testing the impact of STEM and CT on 21st-century skills, and analyzing CT of elementary school students. Meanwhile, the targeted population includes early childhood education, elementary schools, junior

high schools, vocational high schools, and universities. Then, the scope of the material used in the study includes number patterns, integrals, Calculus I, Calculus II, geometry, Pythagorean Theorem, and graphs. Finally, the components of CT include abstraction, decomposition, algorithm, pattern recognition, generalization, debugging, modularity, repetitive actions, simultaneity, and iteration.

Keywords: Computational thinking, Mathematics instruction, Empirical studies

ABS-ICMSCE-24143

**A Systematic Literature Review: Reversible Thinking
in Mathematical Problem-Solving**

Tata Frarisia, Sufyani Prabawanto, Al Jupri
Universitas Pendidikan Indonesia
tatafrarisia@gmail.com, tatafrarisia@gmail.com,
tatafrarisia@gmail.com

Problem-solving skills as one of the fundamental skills in mathematical abilities can be supported by reversible thinking strategies. The problem-solving process involving reversible thinking can assist individuals in considering different perspectives, thus allowing them to explore various options and determine the best solution. Therefore, this research aims to describe the role of reversible thinking in mathematical problem-solving. The research method used is a Systematic Literature Review, which collects primary data published in Sinta and Scopus-indexed journals. Data extraction is tailored to

selection criteria, resulting in 11 articles being gathered. Data analysis employs a qualitative approach. Data grouping is conducted based on the year of publication, the educational level, the analyzed subject, and the role of reversible thinking in problem-solving. The research results show that research discussing the role of reversible thinking in problem-solving abilities has been more frequently conducted at the higher education level with function-related materials. The role of reversible thinking aids in problem-solving abilities by helping students think deeply and understand concepts thoroughly. Given the importance of reversible thinking skills, teachers have a role in optimizing students' reversible thinking abilities.

Keywords: Keywords: reversible thinking, problem-solving, mathematics, systematic literature review, education

ABS-ICMSCE-24145

The Effectiveness of a Project-Based Learning Model with STEM Approach on Students' Mathematical Creative Thinking Ability: A Meta-Analysis Study

Ajeng Nur Aulia Fitriyaningsih
Universitas Pendidikan Indonesia
ajengnaf@upi.edu

Research on the influence of Project-Based Learning (PjBL) models with the Science, Technology, Engineering, and Mathematics (STEM) approach has been extensively conducted, yielding diverse results.

However, it is unknown to what extent study characteristics influence variations in individual study results. As an effort to fill this gap, this meta-analysis research was conducted to determine how the PjBL model with a STEM approach influences overall mathematical creative thinking abilities as well as the role of moderators in implementing it. The data was sourced from Google Scholar and Elicit for research spanning from 2015 to 2024. Eligible studies were included for analysis. Calculations were performed using the Jeffrey's Amazing Statistics Program (JASP), employing random-effects model estimation methods. The research findings, with a total effect size of 0.98, indicate that implementing PjBL significantly impacts on students' mathematical creative thinking abilities. Moreover, the analysis results have implications for future PjBL with STEM approach implementations. The study's limitations are discussed as basic ideas for further research.

Keywords: Meta-Analysis, Creative Thinking, Project Based Learning, STEM, Mathematics Education

ABS-ICMSCE-24152
**THE EFFECTIVENESS OF PROBLEM-BASED
LEARNING (PBL) MODEL ON STUDENTS'
MATHEMATICAL CRITICAL THINKING
SKILLS: A META-ANALYSIS STUDY**

Fauziah Annisa Rahma
Universitas Pendidikan Indonesia
fauziahannisa@upi.edu

Individual studies on the effectiveness of the Problem-Based Learning (PBL) model on mathematical critical thinking skills have yielded mixed results. However, the extent to which research characteristics contribute to the variation in individual study results has not been thoroughly explored. To address this gap, this meta-analysis was conducted to determine the overall effect of PBL on mathematical critical thinking skills. Studies published between 2018 and 2023 were searched using Google Scholar and Elicit databases. The search yielded fifteen studies that met the inclusion criteria for extraction. The calculations were performed using Jeffreys's Amazing Statistics Program (JASP) software, following the stages of investigating publication bias, applying a random effects model, and conducting statistical hypothesis testing. The results indicated an overall effect size of 0.74, suggesting that the implementation of PBL has a moderate impact on students' mathematical critical thinking skills. These results suggest that teachers can use the PBL model to improve students' mathematical critical thinking skills.

Keywords: Critical thinking, problem-based learning, meta-analysis

ABS-ICMSCE-24155

**Unraveling Student Challenges in Problem-Solving:
A Systematic Literature Review Based on Polya's
Framework**

Abdul Wahab A, Dadang Juandi, Yaya S. Kusuma,
Turmudi, Syaiful

Universitas Pendidikan Indonesia
abdulwahabamath@gmail.com, dadang.juandi@upi.edu

This research examines the challenges faced by students in solving mathematics problems based on the Polya framework. Through systematic literature observations, this research identified students' difficulties at four main stages in the Polya framework: understanding the problem, planning a solution, implementing the plan, and looking back. The research results show that at the stage of understanding the problem, students face difficulties in terms of motivation, concentration, reading literacy and mathematical communication. At the completion planning stage, difficulties were found in understanding concepts, connections between concepts, and mathematical modeling. At the plan implementation stage, students often face problems in carrying out algorithms and calculation procedures, as well as accuracy. Finally, at the look back stage, motivation and evaluation of results become the main challenges. This research suggests the need for a more holistic and

structured teaching approach to improve students' problem-solving abilities. The approach should include increased motivation, reading literacy, teaching deeper mathematical concepts, as well as reflective skills. However, this research is limited to qualitative and specific scope, so further research is needed with more diverse methods and a larger sample to gain a more comprehensive understanding.

Keywords: Student Challenges, Problem-Solving, Polya's Framework, Systematic Literature Review

ABS-ICMSCE-24165

**THE EFFECT OF LEARNING STYLES ON
COMPUTATIONAL THINKING ABILITY**

SOLEHUDIN -, Darhim, Dadang Juandi

UNIVERSITAS PENDIDIKAN INDONESIA

solehudin711@upi.edu, darhim0355@gmail.com,

dadang.juandi@upi.edu

Computational Thinking ability is an essential skills in the 21st century that should be considered fundamental and instilled in students from an early age so that they are capable of solving complex problems by adapting computer based approaches to problem solving, thus enabling their success in both their careers and personal lives in the future. Creating learning situations that accommodate diverse individual learning styles is crucial to ensure that every student acquires this capability. The aim of this study is to delve deeper into the impact of

learning styles on computational thinking abilities, and to identify the types of learning styles that have been extensively studied in relation to computational thinking abilities through an exhaustive analysis of diverse research endeavors previously undertaken in this domain. This study is a systematic literature review (SLR) utilizing secondary data samples from journals retrieved through the google scholar database using the Harzing's Publish or Perish application. The identified journals were then selected based on inclusion criteria through the research coding and quality assessment phases. The selected journals underwent descriptive analysis. The research yielded 6 journals that passed the selection criteria. Based on the research findings, it may be inferred that learning styles exert an influence upon students' computational thinking ability, and the Kolb learning style model emerging as a focal point of extensive scholarly inquiry into computational thinking ability.

Keywords: Learning Style, Computational Thinking

ABS-ICMSCE-24179

Mathematics learning tenacity: Is it influenced by student attitudes?

Purwati, Falenthino Sampouw

Universitas Papua

p.purwati@unipa.ac.id, f.sampouw@unipa.ac.id

Penelitian ini bertujuan untuk mengetahui pengaruh sikap siswa terhadap matematika pada keuletan belajar matematika. Penelitian ini merupakan penelitian survei dengan populasi 320 siswa pada salah satu Sekolah Menengah Pertama swasta di Kabupaten Kaimana. Ukuran sampel penelitian sebesar 120 siswa yang dipilih secara proporsional stratified random sampling. Data penelitian diperoleh dengan menggunakan kuisioner sikap siswa terhadap matematika dan keuletan belajar yang telah divalidasi dan diukur reliabilitasnya. Data dianalisis dengan menggunakan statistik inferensi yaitu regresi linear sederhana. Hasil penelitian menunjukkan bahwa terdapat korelasi positif ($r=0,692$) antara sikap siswa terhadap matematika dan keuletan belajar. Selanjutnya, secara statistik terdapat hubungan linear antara sikap siswa terhadap matematika dan keuletan belajar ($F=107,454$; $Sig=0,00$). Selain itu, terdapat pengaruh signifikan yang diberikan oleh sikap siswa terhadap matematika pada keuletan belajar ($t=10,366$; $Sig=0,00$). Hal tersebut menunjukkan bahwa sikap siswa terhadap Matematika mempengaruhi keuletan belajar matematikanya.

Keywords: sikap siswa, keuletan belajar

ABS-ICMSCE-24182
**A Systematic Review of Students' Critical Thinking
Ability In Mathematics Learning: A Review of
Research Between 2019-2023**

Rezi Ariawan
Universitas Negeri Semarang
reziariawan@students.unnes.ac.id

In mathematics learning, there has been an increase and emphasis on developing thinking related to critical thinking skills. This systematic review was conducted focusing on published articles that have explored critical thinking skills in the context of learning mathematics at university. The analyses in this study were conducted to investigate five main issues, including: (1) What kind of interventions are used on critical thinking skills in mathematics learning; (2) What type of research is used in critical thinking skills research in mathematics learning; (3) Whose theories are used related to critical thinking skills in mathematics learning; (4) What teaching materials are used as topics for critical thinking skills research in mathematics learning. To ensure a comprehensive review, researchers used systematic literature review research steps, namely research question, search process, inclusion and exclusion criteria, quality assessment, deviation of protocol. From the review of 31 articles, several findings were obtained, including: (1) the most widely used intervention on critical thinking skills in learning mathematics is the problem-based learning model; (2) quantitative research with quasi-experimental type is most widely used in critical thinking skills research in learning mathematics; (3) Ennis' theory is the theory

that is most widely used in critical thinking skills research; (4) Integral calculus is the teaching material that is most widely used as a research study of critical thinking skills in mathematics learning at the University.

Keywords: Systematic Review, Critical Thinking Ability, Mathematics Learning

ABS-ICMSCE-24195

Comparison of Linear and Exponential Regression Models for Analyzing the Impact of QRIS Usage on Kereta Api Indonesia

Ganesha Gibran, Wahyurini Ediningrum, Jamaludin Abdul Karim

Institut Teknologi Telkom Purwokerto
2211104058@ittelkom-pwt.ac.id, wahyurini@ittelkom-pwt.ac.id, 2211103114@ittelkom-pwt.ac.id

This research is motivated by the importance of Quick Response Code Indonesian Standard (QRIS) for passengers of Kereta Api Indonesia (KAI), the Indonesian Railway Company. It explores the relationship between the adoption of QRIS and customer satisfaction in KAI restaurants. The research aims to understand the influence of QRIS utilization on customer satisfaction. The sampling method used in data collection is Disproportionate Stratified Random Sampling. The instruments used in this research are transaction convenience questionnaires and customer satisfaction questionnaires, which were analyzed using statistical

techniques. The data were analyzed using linear and exponential regression models. Based on the data analysis, it was found that: (1) There is a significant effect of QRIS usage on customer satisfaction, with both linear and exponential regression models; (2) The linear regression equation is shown as $y = 41,263 + 2,080x$, and the exponential equation is shown as $y = [(64,955e)]^{0.016}$. The conclusion of this research is that there is a significant effect of QRIS in enhancing transaction efficiency and customer experience within Indonesian Railway restaurants.

Keywords: QRIS, KAI, Transaction Convenience, Customer Satisfaction, Linear Regression, Exponential Regression

ABS-ICMSCE-24196

Comparison of Exponential and Quadratic Trend Equations on Trans Banyumas E-Money Transactions in 2023

Jamaludin Abdul Karim, Ganesha Rahman Gibran,
Wahyurini Ediningrum, Yogo Dwi Prasetyo
Institut Teknologi Telkom Purwokerto
2211103114@ittelkom-pwt.ac.id,
2211104058@ittelkom-pwt.ac.id, wahyurini@ittelkom-
pwt.ac.id, yogo@ittelkom-pwt.ac.id

This research is motivated by the massive amount of e-money users for transactions in various sectors in Banyumas, Central Java. The study aims to predict the

trend of e-money usage in each Trans Banyumas corridor and compare which method produces better predictions between exponential trend analysis and quadratic trend analysis. The data in this research is secondary data, obtained from monthly e-money transaction records in Trans Banyumas for the year 2023. Based on trend analysis, the research showed that: (1) Using quadratic trend, the R2 of corridor 1 is 0.690, corridor 2 is 0.549, and Corridor 3 is 0.117; (2) Using exponential trend, the R2 of corridor 1 is 0.550, corridor 2 is 0.539, and corridor 3 is 0.000; (3) The quadratic trend analysis consistently gives better results than the exponential trend analysis across all corridors; (4) The corridor that has the best trend is corridor 1, while corridor 3 showed the worst trend. In conclusion, this research shows a positive trend in the use of e-money in Trans Banyumas, particularly in corridors 1 and 2.

Keywords: E-money, Trans Banyumas, Exponential Trend, Quadratic Trend

ABS-ICMSCE-24226
**Profile of Creative Thinking Skills and Character
Global Diversity of Primary School Students: How to
Overcome?**

Ai Juliani

Pascasarjana universitas pakuan
aijuliani777@gmail.com

Ai Juliani; Anna Permanasari; Yuyun Elisabeth Patras
Elementary program - School of Postgraduate Study
Universitas Pakuan
Email: aijuliani777@gmail.com

In accordance with the requirements of the Merdeka learning curriculum in the context of the Indonesian school curriculum, students must be prepared to become generation who are capable in creative thinking and perform character global diversity. Research has been conducted to profile and finding solutions to problems through learning innovation at primary school student context. A total of 52 elementary students were involved in testing creative thinking skills and the character global diversity after going through ethical procedures. The results of the study show that creative thinking of elementary students was still low, and some character global diversity have not developed yet. The quasi-experimental research with the pre-posttest control group design research was then implemented on using model of problem-based learning (PBL) with the Culturally Responsive Teaching (CRT) approach to enhance creative thinking skills as well as character global diversity. The research showed an increase in creative thinking skills

with n-gain scores in the high category, significantly differ from the control class with the lower category. The overall character global diversity for the experimental class were higher than the control class student. By the questionnaire it revealed that learning with PBL-CRT led to the positive responses including feeling happy and learning easier, getting involved along the learning, getting more understanding to the other's culture, as well as student felt happy with the fair rewards. Keywords: culturally responsive teaching; creative thinking; globally diverse character; independent curriculum, PBL

Keywords: culturally responsive teaching, creative thinking, globally diverse character

ABS-ICMSCE-24238

Meta-Analysis: The Effect of Problem-Based Learning Models on Students' Mathematical Problem-Solving Ability

Shafa Salsabila, Endang Cahya Mulyaning A
Universitas Pendidikan Indonesia
shafaasalsabila@upi.edu, endangcahya@upi.edu

This research aims to examine whether there is an influence of Problem-Based Learning models on students' mathematical problem-solving abilities using a meta-analysis method. The population of this study consists of scientific articles published in national journals over the past 10 years that focus on Problem-Based Learning

models. The sample for this research includes scientific articles on Problem-Based Learning and its impact on students' mathematical problem-solving abilities. The research results indicate a difference between pretest and posttest scores of 15.28%. Based on the statistical test results, it is concluded that the use of the Problem-Based Learning model has a significant impact on students' mathematical problem-solving abilities.

Keywords: meta-analysis, problem-based learning, problem-solving ability, mathematical problem-solving ability

ABS-ICMSCE-24258

**Use of LRFM Model for Costumer Segmentation in
The Grocery Industry Sector Using Density Based
Clustering**

Rozan Roif

Universitas Indonesia, Magister Teknik Industri
rozan.roif@ui.ac.id

Grocery trading is one of the biggest industrial and business sectors, especially in Indonesia, where the country is heavily engaged in agriculture. One of the major components of basic food is eggs, and the egg trade is an industry that has a lot of competition from upstream to downstream. Because eggs are a product that is consumed daily by the public, almost all culinary and

catering businesses need eggs. From that need, there are agents or shops that distribute eggs in an area. This research aims to provide customer segmentation and parameters that can help these merchants identify their customer segments using the RFM model combined with the statistical approach of clustering and data distribution. This will greatly help the business develop their marketing and business strategies, by using customer data as a source for statistical analysis, combined with RFM for customer segmentation method, it is hoped that the results of this research will hopefully help categorize the right segments for egg traders in Indonesia.

Keywords: Keywords: Grocery Trade, Customer Segmentation, Marketing Strategy. RFM, Clustering, Statistic

ABS-ICMSCE-24261

Implementation of Illumination Problems to Place Modems in the FPMIPA-UPI Building

Kartika Yulianti, Khansa S. Rohadatul Aisy, Encum Sumiaty, Isniet Yusnitha
Universitas Pendidikan Indonesia
kartika.yulianti@upi.edu

Since a reliable internet signal has become an important and major need nowadays, the existence of modems as transmitters of internet signals is also important; modems transmit the internet signal (without cable) and then it is captured by devices. This research aims to construct a

mathematical model to determine the minimum number of modems and their placement so that the entire UPI building FPMIPA A has a good internet signal. In this research, we assume that the modem can pass through at most two walls, and the area studied is the 1st floor of building FPMIPA A. The model is based on the illumination problems theorems, one of which states that every monotone 6-gon can be covered by a single point 2-modem placed at one of its two leftmost (or rightmost) vertices. By the theorem, we view the layout of the rooms in the building as a combination of polygons. The results show that 12 modems are required to cover all areas on the first floor of building FPMIPA A to get a good signal.

Keywords: Illumination Problems; modem; polygon.

ABS-ICMSCE-24263

Operator Algebras of Self-similar Groupoids

Isniet Yusnitha

Universitas Pendidikan Indonesia

isnieyusnitha@upi.edu

For self similar-actions of groupoids \mathcal{G} on directed graphs E , write as a tuple (\mathcal{G}, E) , will be represented by operators on Hilbert space: the graph E will be represented by a family operators called a Cuntz-Krieger E -family and the groupoid \mathcal{G} will be represented by unitaries such that the two representations satisfy additional relations that are compatible with the self-similar groupoid action. Such a

family operators is called a Cuntz-Krieger (\mathcal{G}, E) -family. We study operator algebras generated by the Cuntz-Krieger (\mathcal{G}, E) -family.

Keywords: groupoids, directed graphs, self-similar actions, operator algebras

ABS-ICMSCE-24015

Insights into Learning Obstacles: A Focus on Student Problem Solving with Simple Structured Data Using Computational Thinking

Nusuki Fatimah, Andini Setya Arianti, Enjun Junaeti,
Putri Zukhruf Dinata

Universitas Pendidikan Indonesia

nusuki.sf@upi.edu, andini.sa@upi.edu, enjun@upi.edu,
putri.zukhruf35@guru.smp.belajar.id

To enhance Informatics teaching quality in junior high schools in Indonesia, understanding students' learning obstacles is crucial within the "Kurikulum Merdeka" implementation. This study investigates how junior high school students learn computational thinking in problem-solving, focusing on simple structured data. Through interviews and work analysis, it aims to identify ontogenic, epistemological, and didactical obstacles. Results show students struggle with specifying problem-solving rules, misinterpreting information, and applying heuristic methods, aligning with these obstacle categories. Addressing these obstacles requires improving instruction, clarifying instructions, and enhancing heuristic fluency and literacy. Collaborative and scaffolded learning approaches are recommended to develop students' computational thinking skills.

Keywords: Informatics, problem-solving, learning obstacle, Computational Thinking.

ABS-ICMSCE-24075

**Evaluation of the Mobile-Based Traditional Game
Application with a User Experience Approach**

Ina Sholihah Widiati, Syams Kurniawan Hidayat, Yeni
Widiyawati, Dwi Septiana Sari
STMIK AMIKOM Surakarta
inasw@dosen.amikomsolo.ac.id

Learning in the digital era is increasingly developing with various types of media. One learning media that is effective in attracting students' interest in learning is game applications. This research discusses the evaluation of learning media in the form of game applications that are integrated into differentiated science learning. One of the advantages of this application is that it is not only a learning medium, but also introduces traditional Indonesian games, especially in Java, called "Engklek". The aim of this research is to evaluate user experiences in using mobile-based game applications as differentiated science learning media. Moreover, this application adopts traditional Indonesian games and uses science learning material. Through transformation into a mobile application, traditional games such as "Engklek" can attract the interest of the younger generation who are more accustomed to digital technology. Thus, this research has the urgency of knowing responses from users directly and getting feedback from users regarding the development of the game application. The method used in this research is a survey using a questionnaire. The questionnaire refers to the User Experience Questionnaire (UEQ) approach. The resulting data from questionnaire respondents will be processed in accordance with UEQ provisions. The

variables used in the evaluation include Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, Novelty.

Keywords: Traditional Game Applications, Learning Media, User Experience, User Experience Questionnaire

ABS-ICMSCE-24098

**A Method for Modeling Temperature Base on
Decision Tree in the Smart Greenhouse**

Dodi Yudo Setyawan, Warsito

Lampung University

adminlms-sk@ darmajaya.ac.id,

warsito@fmipa.unila.ac.id

This study presents a novel temperature modeling method based on decision trees tailored for smart greenhouses. Traditional greenhouse farming often suffers from inefficiencies due to manual control and environmental variability. Smart greenhouses offer precise control over ecological variables by leveraging sensor networks and data analytics. Our research aims to optimize temperature management in smart greenhouses through robust modeling techniques. Decision tree models were trained and evaluated for temperature prediction accuracy by collecting and preprocessing data from greenhouse environments. Results demonstrate that Gradient Boosting outperforms other models, achieving high accuracy in temperature forecasting. Insights gained from experiments shed light on environmental dynamics and

seasonal variations. This research contributes to resource efficiency, crop yield optimization, and the sustainability of greenhouse farming practices. Further exploration into advanced machine learning techniques and long-term validation is recommended for future research.

Keywords: Temperature, Decision Tree, Smart Greenhouse, prediction

ABS-ICMSCE-24190

**Bibliometric Analysis: Trends in Critical Thinking
Assessment Research in Senior High Schools**

January Prayogi, Nahadi, Heli Siti Halimatul

Munawaroh

universitas pendidikan indonesia

januaryprayogi@gmail.com, nahadi@upi.edu,

heli@upi.edu

Critical thinking-oriented education has become a significant focus of the education system in many countries. Critical thinking assessment, which includes various methods and strategies to evaluate students' critical thinking skills, has become a very relevant research subject in improving the quality of education in high school. Research on critical thinking assessment is increasing, but the analysis needs to be improved. Therefore, a comprehensive bibliometric analysis is needed to understand the trends of critical thinking assessment research in high school. This study aims to determine trends and identify the existence of

publications related to critical thinking assessment in high school. The method used in this research is bibliometric analysis. Bibliometric methods can be used to assess the performance and research patterns of authors, journals, countries, and institutions and can be used to identify and measure patterns of cooperation between them (Li & Zhao, 2015). The data is obtained from the Scopus database and then assembled as RIS and CSV files. RIS data will be entered into Publish or Perish (PoP), and CSV data will be entered into the VOSviewer application. The results showed that the trend of publications related to critical thinking assessment in high school has increased and decreased every year. The most cited publication trend was in 2007, with 295 citations. The country with the most publications is Indonesia, which has 20 publications. The ranking of journals with the most publications is in Q1, with as many as 22 journals.

Keywords: Bibliometric, Critical Thinking, Assessment, Senior High Schools.

ABS-ICMSCE-24249
**Graph Visualization Using Python: Spring Layout
with Angle Adjustment**

Agus Komarudin, Wamiliana, Akmal Junaidi, Dian
Kurniasari

Universitas Lampung
2237061001@students.unila.ac.id,
wamiliana.1963@fmipa.unila.ac.id,
akmal.junaidi@fmipa.unila.ac.id,
dian.kurniasari@fmipa.unila.ac.id

Graph visualization is pivotal for understanding the structure and properties of complex networks. Effective node placement is essential to achieve this goal, aiding in understanding the network's structure and characteristics. One commonly employed method for node placement is the spring layout algorithm. This algorithm emulates physical spring forces, drawing connected nodes together while pushing unconnected nodes apart, resulting in an intuitive and easily understandable distribution. However, additional adjustments may be necessary to enhance visual clarity. One approach to improving visualization is by adjusting the angles between nodes. Angle adjustments can help reduce edge crossings and clarify relationships between nodes, particularly in large and dense graphs. This study explores the utilization of Python, utilizing libraries such as NetworkX and Matplotlib, to create informative graph visualizations. Focusing on the spring layout, we delve into practical steps, from reading graph data to drawing the graph visualization. Angle adjustments that evenly divide the circle are implemented

to ensure a more organized layout. Through this research, readers are expected to gain a solid understanding of using Python for graph visualization and the significance of spring layout with angle adjustments in network analysis.

Keywords: Graph, Visualization, Spring Layout, Angle Adjustment, Python

ABS-ICMSCE-24265

Cyber Counselling Modeling with Artificial Intelligence Approach

Prihastuti Harsani, Dwi Prasetyo

Universitas Pakuan

prihastuti.harsani@unpak.ac.id,


dpras.ilkom.undana@gmail.com

Cyber counselling is an information technology innovation for supervising and counselling activities. Cyber counselling involves clients and counsellors being in separate places and communicating with each other privately using the internet network. Cyber counselling has become commonly used in Indonesia since the pandemic in 2020. This has been accompanied by a rapid increase in the field of artificial intelligence. The application of artificial intelligence in cyber counselling can take the form of recommendation systems, auto-bot responses and detection of mental health disorders. Natural language processing (NLP) is a sub-topic in AI that is widely applied in cyber counselling applications.



NLP can extract information that is used to respond, group, and conclude the content of counselling.

Keywords: counselling, artificial intelligence, NLP



ABS-ICMSCE-24021

Unlocking the Enigma: A Literature Review about STEM Learning Research for Fostering ESD Learning Objectives

Rizki Maulana Ashidiq, Chun-Yen Chang, Ari Widodo
Department of Science Education, Faculty of
Mathematics and Science Education, Universitas
Pendidikan Indonesia, Bandung, Indonesia.
rizki.ashidiq@upi.edu, changcy@ntnu.edu.tw,
widodo@upi.edu

The integration of Science, Technology, Engineering, and Mathematics (STEM) learning with Education for Sustainable Development (ESD) has emerged as a popular field of research study. This integration can provide students with rich, interdisciplinary learning opportunities that are grounded in practical, real-world experiences. STEM learning is designed to help students develop a comprehensive understanding of sustainability issues and equip them with the skills needed to address these challenges. Moreover, STEM learning can facilitate students' cognitive domain, students' socio-emotional domain, and students' behavioral domain during conducting STEM projects. The aims of this research are to investigate the effectiveness of STEM learning in achieving the learning objectives set forth by UNESCO for ESD. A systematic review of empirical studies was conducted, focusing on journal articles published between 2020 and 2024. The review process involved using keyword searches and PRISMA techniques to identify

relevant studies within the Scopus database, ensuring a robust and exhaustive collection of data. From this search, twenty journal articles, ranging from Scopus Q1 to Q3 were chosen for their relevance and quality, ensuring that the review encompassed a wide range of high-quality research findings. This diverse range of sources provided a comprehensive overview of the current state of research on STEM learning. The findings from this systematic review suggest that STEM-ESD programs can improve students' cognitive domain by fostering critical thinking and problem-solving abilities. Additionally, STEM learning contributes to students' socio-emotional by encouraging collaborative skills. Finally, STEM learning has a positive impact on students' behavioral domain, such as promoting sustainable practices and decision-making among students.

Keywords: ESD learning, Literature Review, STEM Learning

ABS-ICMSCE-24035

Unraveling the Chain: Mediating Roles of Learning Strategy and Engagement in Engineering Students' Academic Success

Yang Xu, Peng Wang

Xiamen University

1906128913@qq.com, 294283767@qq.com

This study delves into the roles of Power of Learning Strategy (PLS) and Power of Learning Engagement (PLE)

in mediating the relationship between Power of Learning Motivation (PLM) and learning outcomes among engineering students, within the broader context of global engineering education reforms. Utilizing data from the National College Student Survey (NCSS) involving 43,442 college engineering students, the research establishes an intermediary model to examine the interplay between these learning power elements. Through Pearson correlations and K-means clustering, students were categorized into Excellence Challengers, Mediocre Participants, and Superficial Perfunctory groups, based on their learning outcomes. Results indicate that PLM indirectly influences learning outcomes significantly through PLS and PLE, with these mediators accounting for more than half of PLM's total effect on outcomes. This highlights a sophisticated transition from internal motivation to academic success, facilitated by strategic and engaged learning actions, in line with self-determination theory's principles of autonomy, competence, and belongingness. Notably, Excellence Challengers show a pronounced mediation effect, indicative of their systematic approach to converting motivation into concrete results. Furthermore, the study identifies three learning power development cycles among the groups: positive, negative, and undirected. Excellence Challengers display superior motivation, strategy use, and engagement, aligning with a "positive cycle" of learning power. Conversely, Superficial Perfunctory students encounter challenges that lead to a "negative cycle," while Mediocre Participants, despite having growth potential, struggle to effectively translate motivation into learning actions, indicative of an

"undirected state. This research underscores the importance of tailored strategies to bolster academic success across different student types, contributing to the academic discourse by offering insights into the chain mediation effects within the engineering students' learning process. It emphasizes the need for adaptive learning strategies to cater to the diverse educational requirements and potentials of students, thereby enhancing learning outcomes.

Keywords: Learning Power, Engineering Education, Mediation Model, National College Student Survey (NCSS), Student Typologies

ABS-ICMSCE-24082

Proposal for STEAM workshop based on sound and electromagnetism

Hiroki Hayashi, Fumiko Okiharu, Yamato Hasegawa
Tokyo university of science
1723517@ed.tus.ac.jp, okiharu@rs.tus.ac.jp,
hasegawa@hst.titech.ac.jp

The purpose of this study was to design a STEAM workshop where students can learn about sound and electromagnetism, and to investigate the learning effects of this workshop for high school students and above. Specifically, in the process of making a digital piano, students learn about the nature of sound and the role of the electronic components by approaching it from the perspective of physics. The evaluation method adopted a

concept map, which is used as an index to quantitatively evaluate the promotion of cross-disciplinary learning. In addition, in accordance with Bloom's taxonomy of educational goals, we prepared questions on the cognitive and affective domains, and conducted preliminary practice for university students in March. As a result, in the transformation of the concept map, concepts related to the content of the practice were added after the practice, and concepts that were independent before the practice were newly linked together. In the survey in the cognitive domain, the percentage of correct answers for knowledge and understanding was high, but the percentage of correct answers for application was low. In the survey of the affective domain, there were many positive opinions.

Keywords: STEAM, sound, digital piano, workshop

ABS-ICMSCE-24109

**STEM – Project Based Learning Towards
Technology Engineering Literacy (TEL : An Action
Research**

Beatrik Nova, Irma Rahma Suwarma, Nanang Winarno,
Dita Trisna Panjaitan
Universitas Pendidikan Indonesia
beatriknpjtn@gmail.com

This research aims to determine the influence of implementing STEM-project based learning on technology engineering literacy (TEL) among eighth-grade junior high school students in the topic of mirrors

and lenses. The study was conducted using a classroom action research method consisting of two cycles starting from planning, implementation, observation, and reflection. It took place in one private junior high school in the city of Bandung. The research sample consisted of one class comprising 19 students, including 10 female students and 9 male students. The research instrument used was a multiple-choice test with 4 options, totaling 10 questions. Data were analyzed to observe the average student learning outcomes in each cycle. From the data analysis, it can be concluded that STEM-project based learning approach in teaching science subjects on mirrors and lenses can improve students' TEL and shift the focus of learning from teacher-centered to student-centered.

Keywords: STEM, PjBL, TEL

ABS-ICMSCE-24122

How is STEM Low Carbon Education Cultivate Students' Sustainable Consciousness?

Annisa Nurramadhani

Universitas Pendidikan Indonesia

annisanurramadhani@unpak.ac.id

Sustainable consciousness is currently an important thing for students to have, especially prospective teachers as agents of change to prevent climate change from the education area. Education plays an important role in the realization of climate change through STEM low carbon education learning program. This research aims to

investigate how is students' sustainable consciousness through STEM low carbon education learning program. The method that is used is qualitative descriptive method. Data collections is throughout sustainable consciousness for low carbon education questionnaire and interview. The data are analyzed by RASCH model analysis for stacking and racking analysis. The questionnaire is given as pre-test and post-test. This result shows that students' sustainable consciousness is developed after they done the STEM low carbon education learning program. It could be concluded that STEM low carbon education learning program could cultivate students' sustainable consciousness, especially prospective teachers.

Keywords: STEM-LCE; Low-carbon education; Sustainable consciousness; SDGs

ABS-ICMSCE-24127

**Integrating Engineering into K-12 Science: Analyzing
Indonesia's Educational Transformation**

Nurul Fitriyah Sulaeman, Shelly Efwinda, Atin

Nuryadin, Pramudya Dwi Aristya Putra

Mulawarman University

nurul.fitriyah@fkip.unmul.ac.id,

shelly.efwinda@fkip.unmul.ac.id,

atin.nuryadin@fkip.unmul.ac.id,

pramudya.fkip@unej.ac.id

Engineering and engineering education are, therefore, important pieces of the puzzle of addressing future

challenges. However, in the new Indonesian curriculum, engineering education remains unclear. The purpose of this study is to analyze the K-12 science standards of Indonesia that have improved their engineering practices noticeably by integrating engineering and its elements into science learning. For this purpose, K-12 science standard documents were examined with their inclusion and distribution of engineering and its elements across phases. The transformation of education in Indonesia divides K-12 into 6 phases, which are A to C for elementary school, D for junior high school, and E-F for senior high school. The science standard consists of two main elements which are science concept understanding and scientific process skills, both elements stated consistently through all phases. Standards were analyzed through content analysis by employing the Framework for Quality K-12 Engineering Education. The results showed that the integration is varied. As part of the early phase of science standard documents, social science was also integrated with science. The discussion addresses the comprehensiveness of engineering components with science standards and offers implications for the future integration of engineering elements in science education.

Keywords: Engineering; Science; Indonesia; Curriculum; Transformation

ABS-ICMSCE-24144
**HEALTH AND TECHNOLOGY-BASED
LEARNING ABOUT GINGER PLANTS FOR
ADOLESCENT LEARNING**

Junardi Harahap
Universitas Padjadjaran
junardi@unpad.ac.id

Ginger is a herbal plant with so many benefits. Because of the many benefits, a lesson is needed as part of the curriculum to learn about the uses of the ginger plant. In this way, aspects of the properties and benefits of this ginger plant can be conveyed properly. The method used here is a qualitative method using a literature review. The results of the study may be that it is very necessary and very important to create a technology-based curriculum that can be used by teenagers in learning so that ginger plants are sustainable, especially today's teenagers who are very close to technology. The preservation of the ginger plant is very important because, by preserving the ginger medicinal plant, it can be used by our generations into the future. This is an important and good thing about a curriculum that utilizes technology to provide optimal benefits for the future of our nation's herbal plants. Moreover, this ginger plant is a plant that has extraordinary benefits from this ginger herbal plant, and this ginger herbal plant is also a plant that is very used by the public and is very well known today, and this is a very important thing. to preserve herbal medicinal plants. Because of the aspect of use, it is also felt and used by people who use these medicinal plants.

Keywords: Key words: ginger plant, curriculum, education, health, and culture.

ABS-ICMSCE-24160

**PBL-STEM-ESD Learning at Glance: How
Secondary Students Learn Science for 21st Century
Skills**

ANNA PERMANASARI

UNPAK

anna.permanasari@unpak.ac.id

Improving 21st century skills in science learning at schools is an independent curriculum requirement launched by the Ministry of Education and Culture of the Republic of Indonesia in 2018. The qualitative research has been conducted to profile the science learning within depth analysis on how the PBL-STEM-ESD learning provides space to junior high students to practice 21st century skills. The qualitative research was conducted by recording and analyzing science learning at one of the secondary schools in one West Java city, which applied PBL-STEM-ESD learning on alternative energy subject (solar cells). Data collection was carried out for some points of views: classroom-based learning analysis, teacher profile and competency, learning profile that had previously been carried out, and interviews with school principals as policy holders. The results of data triangulation show that learning steps were implemented in accordance with PBL-STEM-ESD steps and able to build students' interest and motivation to learn science. At

each step of learning, the teacher's performance was reflected the efforts to train students' inquiry critical thinking skills (process skills for finding problem solution through basic concepts), creativity (through the stages of design process, product development and product communication techniques), and communicate (during product presentations). A learning process that accommodates all students' potential, the teacher's ability to apply the innovative model, and the support of the school principal caused high learning motivation of student. By the teachers interview and learning outcome data, the innovative action led to the higher learning outcomes, especially students' 21st century skills.

Keywords: Project based learning; STEM, ESD, 21st Century skills; Science Curriculum

ABS-ICMSCE-24167

STREAM in Science Education: Challenge to Enhance Creative Thinking Skills and Spiritual Quotient for Society 5.0

Lilis Siti Hindun Khatimatussa'diyah Zein, Anna Permanasari, Prasetyorini Djarot
Pakuan University
072622012@student.unpak.ac.id,
anna.permanasari@unpak.ac.id,
prasetyorini@unpak.ac.id

Society 5.0 leads to the demands of the enhancing creative thinking skills and spiritual intelligence (SQ) to prepare for the complexity and dynamics of the digital era. The research aims to study the profile of science education on sustainable lifestyle theme based on Science, Technology, Religion, Engineering, Art, and Mathematics (STREAM) and its impact to the creative thinking skills and spiritual quotient (SQ) of senior high school students. The study was conducted using a quasi-experimental method involving 329 students from 10 Islamic-based high school education units in Sukabumi Regency and Sukabumi City representing 33 schools. The instruments used were observation format, creative thinking skills test questions and SQ questionnaires. The subjects of the study were determined on using probability cluster sampling technique. Although this model is the first time being implemented, STREAM learning provides the mutual learning so that it impacts to the increasing students' critical thinking skills (although with low category) and increasing students' SQ (very high category). To make a significant impact especially in creative thinking skills, it

is recommended that STREAM learning or other contemporary learning approaches often used in Science learning for habituation learning process.

Keywords: Creative thinking skills, Science education, Society 5.0, STREAM, Spiritual Quotient

ABS-ICMSCE-24198

Investigating the Dynamics of Changes in Teacher Perceptions of Coding Robotics in STEM Teaching Through the Teacher Professional Development Program

Astrino Purmanna
University of Jember
astrinopurmanna@gmail.com

This research aims to determine changes in teachers' perceptions after participating in STEM coding robotics training and explore recommended ideas for implementing coding robotics in classroom learning. Considering that teacher perception is an important thing in the integration of STEM education, so far little is known about teachers' perceptions of the integration of STEM education, especially in teaching robotics coding. This type of research is pre-experimental: the design collective-group pretest-posttest. The research sample involved 41 teachers from elementary school to senior high school level in East Java, Indonesia. Collecting research data in the form of pretest and posttest as filling in questionnaires by teacher professional development

program participants. Teacher perception data was analyzed using non-parametric chi-square and paired samples t-test to test the effect of participating in training program, while teacher recommendation data regarding ideas for implementing coding robotics were analyzed using thematic descriptive. The results show that there is no significant association between the dimensions of gender, years of teaching, and specialization with teachers' perceptions of mastery of coding robotics skills. However, the through STEM coding robotics training program provides significant dynamic change in teachers' perceptions of mastery of coding robotics skills. Other results are described in detail in this paper which include the association between teacher perceptions and the dynamics of changes in teachers' perceptions of coding robotics when applied in elementary school to senior high school. Furthermore, this research also revealed that there were eight teacher recommendations regarding ideas for implementing coding robotics after participating in the training program, one of which was to create an innovative work project. Based on these findings, it is possible to have further discussions about how to support teachers to implement STEM coding robotics learning in schools in a systematic way.

Keywords: coding, robotics, STEM, teacher perceptions, teacher professional development

ABS-ICMSCE-24228

Gender Difference on Critical Thinking of Secondary Students after The Implementation of PjBL-STEM

Rahmah Evita Putri, Aristo Hardinata, Rani Oktavia,

Monica Prima Sari

Universitas Negeri Padang

rahmahep@fmipa.unp.ac.id,

aristohardinata@unimed.ac.id,

oktanivia2034@fmipa.unp.ac.id,

primasarimonica@fmipa.unp.ac.id

A study was conducted to measure the effect after implementation of PjBL-STEM on critical thinking for secondary students. This research involved 128 students who attend the science class at secondary school Padang. Sampling was done by purposive sampling method. The PjBL-STEM model was used under Laboy-Rush steps (2010). The critical thinking of students was measured by using an Ennis Critical Thinking Indicators. The instrument used was developed under the Ennis indicator and validly used to measure the critical thinking for secondary school students. The result shows that there is a significant difference between male and female critical thinking after the implementation of PjBL-STEM.

Keywords: Gender Difference, Critical Thinking, PjBl-STEM

ABS-ICMSCE-24xx

**Visualizing Different Gender Students'
Emotional Experience of Learning: Based on
Large Data of Artificial Intelligence
Assistant in Classroom**

LiShuang

The quality of classroom instruction can be evaluated by observing students' facial expressions. By recognizing students' expressions during class, teachers can identify which teaching activities trigger specific emotions and understand how these emotions relate to learning tasks, thereby adjusting their teaching decisions. We have constructed a five-dimensional analytical framework for students' classroom emotional experiences, which includes surprise, happiness, neutrality, sadness, and annoyance. Annoyance is a combination of disgust, anger, and fear. The Artificial Intelligence in the Classroom (AIAC) system enables big data visualization of learning emotional experiences for students of different genders, combined with classroom video analysis of key events. Further, based on this model, this study collected emotional experiences from 43 Chinese high school students during mathematics classes and analyzed the real-time visualized emotions related to learning activities, learning tasks, and learners' gender. This study provides preliminary research and exploration on AI-enabled classroom instruction.

Key words: Emotional experience, Student learning, different gender, Visualization, Big data

ABS-ICMSCE-24xx

The Promotion of Teacher's Commognition to Students' Commognition during Online One-to-One Mathematics Teaching: The Mediating Effect of Teacher's Emotion

Pan Tuo


2School of Education, Shaanxi Normal University, Xi'an
People's Republic of China

* Correspondence:

Pan Tuo

tuopan031@126.com; szh@hznu.edu.cn

Artificial intelligence stimulates and promotes continuous innovation in education in multiple dimensions, Continuous integration of artificial intelligence technology into online teaching to achieve personalized teaching. The participants were a 6-years mathematics teacher and a 15-year-old boy in China, who have done computer-supported one-to-one teaching. We collected three computer-supported one-to-one teaching videos (About 90 min) about the concept of function, the basis of function representation and piecewise function and mapping. The main findings of the current study showed that teacher commognition affects students' commognition through teacher emotion and there is a certain correlation between teacher's commognition and



student's commognition. We explored the internal mechanism of teacher commognition affecting student's commognition, and provided empirical research and theoretical support for online teaching to adjust teacher emotions to promote students' commognition deepening, thereby improving the efficiency of online teaching. At the same time, this research provides a certain basis for the deep integration of artificial intelligence and education in the future.

Key words: computer-supported, commognitive, one-to-one teaching, teacher's emotional, visualization



ABS-ICMSCE-24014

**Advancing Students' Sustainability Awareness
through Proyek Penguatan Profil Pelajar Pancasila
Rahmatan Lil 'Alamiin (P5RA): Insights from the
Save The Earth Campaign**

Nurul Inayah Khairaty

Universitas Negeri Yogyakarta

nurulinayahkh.edu@gmail.com

This study explores the effectiveness of the Proyek Penguatan Profil Pelajar Pancasila Rahmatan Lil 'Alamiin (P5RA) in enhancing students' awareness and understanding of sustainability concepts as part of the broader Save The Earth campaign. The P5RA, rooted in the Indonesian educational framework of Pancasila and the principle of Rahmatan Lil 'Alamiin, emphasizes holistic development, ethical comportment, and environmental stewardship. Through a mixed-methods approach, incorporating both quantitative surveys and qualitative interviews, this research investigates the impact of P5RA on students' perceptions, attitudes, and behaviors toward sustainability issues. The study sampled 72 MAN Insan Cendekia Gowa students, a school implementing sustainability through the P5RA. The quantitative data was analyzed using paired sample t-tests to determine the differences in sustainability awareness, attitudes, and behaviors pre-and post-intervention. Regression analysis identified predictors of positive change in sustainability-related outcomes. NVivo software facilitated the organization and analysis of

qualitative data, ensuring thematic consistency and reliability. Findings indicate a significant increase in students' sustainability awareness and enhanced motivation and engagement in environmental preservation activities. The study further elucidates the role of culturally embedded educational methodologies in fostering a deeper connection with sustainability issues, suggesting that the P5RA approach can effectively integrate sustainability into educational curricula. The implications of these findings for educational policy and practice, particularly in the context of global sustainability challenges, are discussed. This research contributes to the literature on sustainability education by demonstrating the potential of culturally contextualized educational methodologies to advance sustainability awareness among students.

Keywords: P5RA, Save The Earth, SDGs, Sustainability Awareness

ABS-ICMSCE-24016

**Sustainability Awareness Profile of Students through
Education for Sustainable Development (ESD)
Integration in Science Learning on the Topic of
Environmental Issues Among Secondary School**

Rizky Agassy Sihombing, Dr. Muslim, M.Pd., Dr.

Taufik Rahman, M.Pd.

Universitas Pendidikan Indonesia

rizkyagassy@upi.edu, muslim@upi.edu,

taufikrahman@upi.edu

Education for Sustainable Development (ESD) is crucial for pillars of human development: social, economic, and environmental preservation. It's a global responsibility transcending national boundaries especially in Indonesia, requiring collective action to ensure a sustainable future generations. The primary objectives are to delineate and categorize sustainability awareness profiles, focusing on emotional, behavioral, and practical dimensions, while also exploring gender-based differentials and grade levels. This study employs a descriptive research method, utilizing a Guttman scale questionnaire adapted from Hassan et al. The target samples consists of 87 secondary school students in SMPN 36 Bandung, with the aim of gaining a comprehensive understanding of sustainability awareness. The results indicate commendable overall sustainability awareness, with emotional awareness leading at 95.7%, followed by behavioral and attitude awareness at 83.5%. However, practice awareness lags behind at 56.3%, suggesting a potential area for improvement. Interestingly, female students demonstrate higher awareness at 79.9% compared to males at 75.3%,

and students in seventh-grade demonstrate higher awareness at 82.0% compared to ninth-grade at 77.1%. In conclusion, this study highlights the crucial role of ESD in nurturing sustainability awareness among secondary school students. While commendable awareness levels were noted in emotional, behavioral, and attitude dimensions, a significant gap in practice sustainability awareness remains. Gender and grade-level disparities further emphasize the need for targeted educational interventions to bridge these gaps and ensure equitable participation. By addressing these challenges, educational initiatives can empower young learners to tackle global sustainability issues and pave the way for a more sustainable future generations.

Keywords: Students Profile, Sustainability Awareness, Education for Sustainable Development, Secondary School

ABS-ICMSCE-24022

Bridging Knowledge Divides, Breaking the Hegemony: Culturally Relevant Science Teaching for Sustainable Knowledge Systems

Karizza Jane Pejaner, Sally B. Gutierrez
University of Southern Mindanao PALMA Cluster
Campuses

kjbpejaner@usm.edu.ph, sbgutierrez@up.edu.ph

Science teaching has historically placed less emphasis on indigenous knowledge, unintentionally privileging

Western science. Western science has dominated not just the global knowledge production but also educational resources which leads to suppression and marginalization of indigenous knowledge systems and practices (IKSP). However, IKSP were considered an integral part of the survival of indigenous communities. Thus, it should not be neglected and considered inferior as compared with Western science. Culturally relevant science teaching (CRST) aims to disrupt this hegemony by recognizing and valuing diverse knowledge systems and ways of knowing. Drawing on Critical Theory as a research framework, the study explores the historical context of Western science, the comprehensive examination of CRST and its potential in promoting sustainable knowledge systems, and challenges in its implementation. The methodology employed qualitative document analysis, examining historical documents, scientific writings, and educational policies related to Western science hegemony and CRST. Results highlight the limitations of Western science and possibility of using IKSP in teaching and learning. Also, it acknowledges the potential of CRST to empower marginalized communities. Challenges in implementation, including teacher training and resource availability, are acknowledged. Thus, the study advocates for the institutionalization of CRST in science education, integration CRST in science curricula, and provision of teacher training to foster sustainable and inclusive education.

Keywords: Culturally Relevant Science Teaching, indigenous knowledge, science education, Western science

ABS-ICMSCE-24030
**Developing Science Teachers' Teaching Skills for
Natural Disasters: Through the Use of Ancestors'
Views on Nature as Reflected in Folktales**

Karen Onodera, Hiroki Fujii
Kyoto Koka Women's University
k-onodera@mail.koka.ac.jp, fujii-hi@okayama-u.ac.jp

Using stories like folktales in elementary science education can be a powerful tool for teaching about natural disasters. Folktales offer insights into how ancestors, who lived in coexistence with nature, understood its blessings and furies. This study aims to integrate these perspectives into elementary school teacher training programs to develop effective teaching skills for natural disasters. We developed lectures for a mandatory 'Science' course, integrating a science lesson with a folk tale about a river to highlight the nature-human coexistence. Trainees then created their own lesson plans, reflecting the ancestors' views on nature as depicted in the folk tale. To assess the effectiveness of the lectures, we utilized questionnaires that measured the trainees' understanding of the human-nature relationship in the context of natural disasters. The questionnaire results indicated that 21 out of the 24 trainees recognized the importance of developing elementary school science lessons on natural disasters that take into account the coexistence between rivers and humans, including potential future dynamics. Additionally, we found that it is crucial to enhance the trainees' understanding of the dual aspects of rivers—their blessings and furies—as well as the broader relationship between nature and humans,

such as the limitations of human control over rivers and the mechanisms underlying natural disasters. Our results suggest that the lectures effectively enhanced the trainees' understanding of the value of science lessons that consider the coexistence of nature and humans as reflected in folktales, indicating an improvement in their teaching skills for natural disasters.

Keywords: Coexistence between Nature and Humans, Ancestors' Views on Nature, Folktales, Natural Disasters, Elementary Science Education, Teacher Training

ABS-ICMSCE-24034

Questionnaire survey on memories and knowledge of past mega earthquakes for second-year students of the Faculty of Education: Disaster Prevention Science Education

Tomohiro Takebayashi, Nurul Fitriyah Sulaeman
Faculty of Education, Art and Science, Yamagata
University; Museum of Natural and Environmental
History, Shizuoka
taketomo.geology@gmail.com,

Japan and Indonesia experienced frequent earthquakes. In Japan, 13 years have passed since the Great East Japan Earthquake M9.0 and 29 years since the Great Hanshin-Awaji Earthquake (M7.3). The former was a plate slip, and the latter was a reverse fault break in the surface crust, both of which caused many deaths. In Indonesia, 20 years have passed since the Sumatra earthquake M9.0 (plate

slip). In this study, questionnaires on knowledge and memory of earthquakes in their country were collected from second-year undergraduate students of the Faculty of Education at Shizuoka University (South-Central Japan region) and Yamagata University (Northeast Japan region) in Japan and Mulawarman University in Indonesia. First, 88 students from Mulawarman University had seen videos of the Sumatra earthquake, of which 45 students (51%) had seen videos of the Sumatra earthquake. On a five-point scale (5: strong; 1: weak), 43 students (50%) chose 1 or 2 (n=86) for their memories of the Sumatra earthquake. Second, in the Japanese case, more than 99% of the students in both Shizuoka (n=85) and Yamagata (n=75) had seen a video of the Great East Japan Earthquake. The level of knowledge of these students was 88–89%, with ‘5: strongly know’ and ‘4: know’ in the five-point questionnaire. On the other hand, 34% (n=29) of the students at Shizuoka University and 73% (n=47) at Yamagata University had seen a video of the Great Hanshin-Awaji Earthquake. The results of the five-level questionnaire on knowledge about the earthquake confirmed that the histogram shifted to a lower range for the group of students who answered that they had never seen the video in common with both universities. Hence, it is clear that recording and constantly communicating earthquake videos is an important factor for disaster prevention and mitigation in future earthquake disasters in order to establish memories and knowledge of major earthquake disasters. Future science education in Japan is aimed at Society 5.0 (Cabinet Office), and ICT and STEAM education are being promoted. Therefore, instead of teaching pictures in

conventional textbooks, the development of teaching materials, such as video, should be promoted. This presentation also introduces teaching materials, museums, and remains for disaster education in the Tohoku region of Japan.

Keywords: ESD, STEM, Earthquake, Education for disaster prevention, Geoscience, Society 5.0, ICT

ABS-ICMSCE-24039

Analyzing Publication Trends in Education for Sustainable Development Integration: A Bibliometric Study (2019-2023)

Haryanto Haryanto, Sjaeful Anwar, Rini Solihat, Dewi Sulistyowati, Waliyyatu Azzahra, Zuana Habibaturohmah

Universitas Pendidikan Indonesia

haryanto10@upi.edu, saefulanwar@upi.edu,
rinisolihat@upi.edu, dewisulistyowati23@upi.edu,
waliyyatuazzahra@upi.edu,

Education for Sustainable Development (ESD) has increasingly become a pivotal framework for nurturing global awareness and prompting action toward environmental preservation, social equity, and economic progress in recent years. This study endeavors to examine publication trends concerning the integration of ESD into learning from 2019 to 2023. We visually dissected bibliographic data using VOSviewer software alongside bibliometric analysis tools such as RStudio and

biblioshiny. Among the 738 documents sourced from the Scopus database, we observed fluctuating publication patterns, with Sustainability (Switzerland) emerging as the foremost contributor, totaling 201 documents. Spain led in ESD-focused publications, with a tally of 294. Noteworthy institutions included Fujian Medical University and Uppsala University, yielding 27 and 23 publications, respectively. Universitas Pendidikan Indonesia prominently represented Indonesia. Matthias Barth, hailing from Germany, emerged as the top author with 11 documents. The most globally cited documents, published in the Sustainability Science Journal, accrued 236 citations. Analysis of research trends highlighted prominent themes such as ESD, Sustainable Development, Sustainability, SDGs, and Learning while also shedding light on underexplored domains, including learning systems, deep learning, mobile learning, teacher training, climate change education, critical thinking, sustainable education, and AI. This study underscores the imperative to further explore and invest in ESD across diverse arenas to address sustainability challenges and foster societal resilience and equity. It advocates for future research endeavors integrating diverse data sources, bibliographic connections, and qualitative analyses.

Keywords: bibliometric analysis, esd, learning

ABS-ICMSCE-24041

**How Hot is it in 2100? Middle School Science Lesson
on Future Climate**

Khalifatulloh Fiel'ardh, Hiroki Fujii, Kazunori Iwata,
Yasuhiko Ogura, Mako Koeda
Okayama University

Aldi@okayama-u.ac.jp, fujii-hi@okayama-u.ac.jp,
Aldi@okayama-u.ac.jp, Aldi@okayama-u.ac.jp,

Climate Change Education (CCE) is an essential component of the modern science curriculum, focusing on the temporal context by addressing historical, current, and future climate scenarios. This research project highlights the integral role of simulations within the science curriculum, merging science, technology, and social studies to examine the potential ecological and economic impacts of climate change. Through the use of data modeling and scenario-based learning, simulations deepen students' understanding of the interconnected nature of climate issues. This approach was implemented in the "Nature and Humans" unit for third-year middle school students (n =176) in Okayama, Japan, focusing on developing futures thinking competencies. These competencies include: (1) envisioning multiple climate futures, (2) applying precautionary principles, (3) evaluating the effectiveness of interventions, and (4) managing climate-related risks. The first lesson delved into historical climate trends, emphasizing the urgent need to limit global warming to 1.5°C. The second lesson engaged students with simulation software to explore the consequences of various environmental decisions through scenario-based exercises. To assess the effectiveness of

the developed lessons, various evaluation method were employed, including observation notes, open-ended questionnaires, group worksheets, and reflection notes. These tools provided insights into the student's learning processes and outcomes, indicating a marked improvement in their futures thinking competencies. Integrating such simulations into the science curriculum offers students a rich educational experience that is both informative and engaging, effectively preparing them to comprehend the complexities of other environmental challenges.

Keywords: Middle School Science, Climate Change Education, Futures Thinking

ABS-ICMSCE-24047

How is CO₂ Changing the Seawater? Middle School Lessons on Ocean Acidification

Asami Kajita

Graduate School of Education, Okayama University
p7eg2p05@s.okayama-u.ac.jp

Climate change is causing several environmental issues, with ocean acidification (OA) being one of the most significant. OA occurs when more CO₂ dissolves into the seawater from the atmosphere, changing the water's chemistry and inhibiting the growth of marine organisms. Despite its importance, OA is rarely included in the Japanese school science curriculum. Our research aims to fill this gap by introducing innovative lessons to 145 third-

year middle school students, focusing on OA's mechanisms and impacts on marine organisms. We developed and implemented two lessons. Lesson (1) detailed the factors influencing OA, incorporating an experiment where students observed a color change in an indicator solution due to CO₂ absorption, illustrating the chemical processes of OA. Lesson (2) explored OA's impact on sea snail that rely on calcium carbonate (CaCO₃) for their shells. Based on the pre- and post-test results, there was a significant improvement in average scores following the lessons, demonstrating enhanced student understanding of OA's mechanisms and impacts on marine organism. Notably significant changes were observed in students' understanding of the impact of industrial activities on seawater acidity and the effects of OA on shell formation. The next phase of our research will concentrate on developing evaluation methods to better gauge and improve students' understanding and retention of OA concepts.

Keywords: Climate Change Education, Ocean Acidification, Middle School Science

ABS-ICMSCE-24074

**Exploring Opportunities and Challenges in
Implementing STEM-ESD Learning in Education: A
Systematic Literature Review**

Zuana Habibaturohmah, Ida Kaniawati, Rini Solihat,
Haryanto

Universitas Pendidikan Indonesia

zuana.habibaturohmah@upi.edu,

idakaniawati@upi.edu, rinisolihat@upi.edu,

haryanto10@upi.edu

Combining STEM education with Education for Sustainable Development (ESD) has the potential to foster innovation and creativity in achieving sustainable development goals within the educational field. The integration of STEM education with ESD principles offers a conducive environment for students to develop socialization skills and acquire knowledge and competencies relevant for the 21st century. The primary aim of this research is to examine existing empirical studies on the implementation of STEM-ESD learning and explore their opportunities and challenges on education. Employing the PRISMA 2020 systematic literature review method and utilizing Scopus as the primary database, a total of 160 articles were initially gathered, with only 20 meeting the criteria for thematic-qualitative analysis. This study finds that implementation of STEM-ESD learning has opportunities and challenges: 1) The opportunities of STEM-ESD learning: enhanced student understanding of interdisciplinary connections, comprehensive development of student skills, increased student awareness of environmental and sustainability

issues, equipping students with skills to address real-world problems, and increased creativity and innovation among teachers and students; 2) The challenges of STEM-ESD learning: lack of readiness among teachers to integrate ESD into STEM learning, curriculum inadequacies, limited school resources and facilities, insufficient support from the stakeholders, lack of student interest and capacity.

Keywords: STEM education, education for sustainable development

ABS-ICMSCE-24084

**Mapping Research Themes and Future Direction in
Research Skills of Undergraduate Research: A
Bibliometric Approach**

Anisatuz Zahro', Muzzazinah, Murni Ramli

Universitas Sebelas Maret

anisatuzzahro@student.uns.ac.id,

yinmuzzazinah@staff.uns.ac.id,

mramlim@staff.uns.ac.id

This study aims to provide a comprehensive overview of the current state and future research potential in the area of students' research skills and competence. Due to the increasing number and diversity of research in this field, a quantitative approach is necessary to assess article performance, map existing research themes, and identify potential areas for future investigation. A bibliometric analysis was conducted using 613 bibliographic sources

from Scopus to achieve this objective. The analysis results were visualized using VOSviewer and Bibliometric R-package, employing bibliographic coupling, co-citation, co-occurrence, and thematic mapping techniques. The analysis findings reveal a significant growth in publications and citations within 2013 - 2023, with most of the publications falling within the social science field (371 publications). The United States and the University of Adelaide were identified as the leading contributors in the number of articles. English emerged as the most commonly used language, and journal articles were the predominant document type. The research topics that received significant attention included research skills, higher education, critical thinking, project-based learning, qualitative research, and medical students. Future research may focus on research skills, experiential learning, active learning, qualitative research, and graduate students. The insights gained from this study provide valuable guidance for developing practical research skills by identifying popular research topics and emerging subject areas. Overall, this research contributes to our understanding of current and future research trends in the field of students' research skills.

Keywords: Bibliometrics, Research Skills, University, Science Mapping, VOSviewer

ABS-ICMSCE-24114
**Middle School Students' Perceptions about Climate
Change, Behaviours and Habits in the Sustainable
Development Domain**

Naufal Rabah Wahidin, Riandi, Lilit Rusyati
Universitas Pendidikan Indonesia
naufalrabah@upi.edu, rian@upi.edu,
lilitrusyati@upi.edu

Climate change and environmental issues have emerged as significant global concerns. Addressing these issues aligns with the objectives of sustainable development goals. However, limited research has explored students' perceptions on this matter. Considering that today's students will become the primary influencers and decision-makers of the future, it is crucial to gain a deeper understanding of their beliefs and attitudes towards sustainable development. This study seeks to gather information regarding students' perceptions of climate change and their behaviors and habits in the sustainable development domain. The sample is made up of 186 students from one private junior high school in Bandung. Data were collected using a questionnaire which consisting of twenty items and categorized into five factors, reuse and reduce, climate change concern, activities organized by school, contributing to environmental protection, and recycle. The findings indicate that 53% of students are familiar with practices related to the reuse of materials and the reduction of material consumption, which have a significant environmental impact. Additionally, 73% of students believe that climate change can affect human lives and

advocate for government policies in response. Moreover, 55% of students actively participate in school environmental and social activities, while 34% engage in environmental initiatives. Furthermore, 72% of students are actively involved in recycling activities. The results lead to the conclusion that implementing various actions is necessary to enhance students' knowledge regarding climate change and to positively influence their behavior and habits towards the environment.

Keywords: sustainable development, climate change, science education

ABS-ICMSCE-24151
**Analysis of Sustainable Lifestyle Projects in Junior
High School**

Gita Nurul Puspita
Universitas Pendidikan Indonesia
gitapuspita@upi.edu

This research aims to analyze the module of the Pancasila Student Profile Strengthening Project on the Sustainable Lifestyle Theme in Junior High Schools. This research is a document analysis with a qualitative approach. The subject of this research is the module of the Pancasila Student Profile Strengthening Project with the Sustainable Lifestyle Theme in Phase D, which is available on the Merdeka Mengajar Platform and has been curated by the Ministry of Education, Culture, Research, and Technology. From the results of the analysis of 42

modules, it is known that the issues raised in the project are still limited. Most modules are modules related to waste management projects at 62%, which focus on achieving ESD Learning Objectives on SDG 11, 12, and 15. The skills or values that are most often strengthened through these projects are faith, devotion to God Almighty, and noble character, collaboration, and creativity. The assessments most widely applied in learning are performance observation sheets and student reflection sheets. This research illustrates that students need to be introduced to a more diverse range of sustainability issues.

Keywords: Sustainable Lifestyle Projects, SDG, module, Pancasila Student Profile Strengthening Project

ABS-ICMSCE-24173
**THE DEVELOPMENT OF TEACHING
LEARNING APPLICATION IN EDUCATION FOR
SUSTAINABLE DEVELOPMENT (ESD) TO
IMPROVE STUDENTS CRITICAL THINKING
AND SUSTAINABILITY AWARENESS IN
BIODIVERSITY**

Ekسا Sunarya, Ekسا Nursafira Sunarya
Universitas Pendidikan Indonesia
eksasunarya@upi.edu, eksasunarya@upi.edu

Technological developments in this era are experiencing rapid progress. Especially in the field of science, everyone refers to education that will trend in

the 21st century. Where education will become very modern with the help of many technologies to support student learning. The android-based application is now days used in order to engage students' understanding of science learning. In this work, we will propose a android learning application, named "BioD", as interactive multimedia for Sustainable Development. This application discusses biological material on the topic of the Biodiversity. This application is made using 3 learning platform such as Canva, Thinglink, and Nearpod. Canva, Thinglink, and Nearpod are three different software that have different function to make a learning application more interactive and interesting. Researchers have evaluated this device. The results showed that based on content expert evaluations, the average learning activities score was 96%, language evaluation based on experts was 82.50%, and media design (IT) rated an average of 87.93% from the range 88, 81%. As well as based reviews from science teachers and junior high school students the percentage of learning applications is 90.55% and 92.50. Based on this, the Learning application is very suitable for use as a learning application. This application is dynamically designed and equipped with various supporting features, such as: images, videos, tags, open ended question, drawing activity, multi-language animation settings, and so on. The author

suggests that this application can continue to be developed in future studies.

Keywords: Biodiversity, Canva, Thinglink, Nearpod, Learning Application, Education for Sustainable

ABS-ICMSCE-24175

**Integration of ESD and Green Chemistry in the
Nanomaterials Learning**

Niva Nurjiwa

Universitas Pendidikan Indonesia

nivanurjiwa@upi.edu

Education for Sustainable Development (ESD) is an important part of the Sustainable Development Goals (SDGs). Integrating ESD and green chemistry into learning is a step towards realizing the sustainability goals. Teachers through their learning in the classroom play an important role in promoting the achievement of all SDGs. The purpose of this study was to determine the opinion of chemistry teachers about the importance of integrating ESD and Green Chemistry in learning about nanomaterials at school. A descriptive qualitative research method was used in this study with participants of 45 chemistry teachers in Bandung City. Data collection was conducted using a questionnaire consisting of 10 questions about the importance of chemistry learning with ESD and Green Chemistry and 4 questions about the importance of ESD and Green Chemistry integration in learning nanomaterial topics. The results showed that

60% of participants strongly agreed that topics in chemistry learning have the potential to be associated with the concepts of ESD and Green Chemistry. Based on the frequency of ESD enhanced chemistry learning that has been done by teachers, 46.7% of participants indicated that chemistry teachers have often linked chemistry learning with ESD concepts. Although most participants were enthusiastic about the integration of ESD and Green Chemistry, 44.4% of participants only occasionally linked sustainable chemistry issues to nanomaterials learning.

Keywords: ESD, green chemistry, chemistry learning, nanomaterials learning

ABS-ICMSCE-24184
**KNOWLEDGES AND PERCEPTIONS ON
EDUCATION FOR SUSTAINABLE
DEVELOPMENT OF PRIMARY PRE-SERVICE
TEACHERS**

Diana Ayu Rostikawati
Universitas Pendidikan Indonesia
dianaayu89@upi.edu

Education for Sustainable Development (ESD) is vital for students worldwide because it equips them with the knowledge, skills, attitudes, and values needed to secure a sustainable future for humanity at both local and global levels, a pressing need in today's world. ESD should be an ongoing part of both formal and informal education, across all educational levels, including lifelong learning

programs, starting from primary education. This study investigates knowledges and perceptions of primary pre-service teachers at the Universitas Bina Bangsa in Serang city. This study using a quantitative approach involving a questionnaire. The results indicate that while most pre-service teachers possess knowledge about ecological/environmental dimension, they tend to overlook the social, law and economic dimensions of ESD. However, the findings reveal that pre-service teachers recognize the importance of ESD, advocate for its inclusion in curricula, and believe that incorporating ESD lessons during their training would enhance their ability to teach ESD effectively to their future students.

Keywords: Keyword: Knowledges; Perceptions; Education for Sustainable Development

ABS-ICMSCE-24199

Exploring sustainability awareness as a profile of environmental attitudes towards secondary education in Jepara, Central Java.

Umi Sayidatus Zakiya

Universitas Pendidikan Indonesia

umi.zakiya@upi.edu

This paper explores the variability of sustainability consciousness among junior and senior high school students in Jepara, Central Java. Utilizing survey data, the study aims to elucidate the current status and future prospects of education for sustainable development, with

a particular focus on secondary education. The research analyzed 85 responses from students in junior and senior high schools in Jepara, using the Gericke et al. (2019) Sustainability Consciousness Questionnaire. Additionally, the study examined the influence of two variables—gender and grade level—on the students' level of sustainability consciousness. The analysis revealed no significant gender-based differences in sustainability consciousness between female and male students. However, academic progression was found to influence sustainability consciousness, with high school students demonstrating greater consciousness compared to junior high school students. Overall, the findings indicated that students' sustainability consciousness had a mean score of 3.33 out of 4, categorizing it as high. It can be concluded that the sustainability consciousness of students at the junior and senior high school levels in Jepara is high across all categories: sustainability knowingness, sustainability attitudes, and sustainability behavior. This research has implications for educational institutions and policymakers to ensure dedicated efforts to promote and integrate education for sustainable development into the educational system and achieve sustainability goals by 2030.

Keywords: Sustainability consciousness, Education for sustainable development, Secondary education, Jepara

ABS-ICMSCE-24200
**The Effect of Experience Learning Models
Containing ESD on Students' Critical Thinking Skills
and Integrated Problem-solving Competencies**

TAJ ROSYIDAH

Magister Pendidikan IPA Universitas Pendidikan
Indonesia

tajrosyidah@upi.edu

Indonesia's ranking in PISA 2022 shows an increase of 6 levels in scientific literacy compared to the previous year (Kemendikbudristek, 2023), but from these results the scientific abilities of Indonesian children are still below the international average. Therefore, students' critical thinking skills still need to be trained through learning innovations. Students who have critical thinking skills can solve real-world problems that will be faced when they become members of society. The problem solving process also requires other integrated competencies to become a member of a sustainable society (UNESCO, 2018). This competency is Integrated Problem-solving (IPs) competency as a core competency. Education for Sustainable Development (ESD) must also be trained so that students are ready to become members of a sustainable society. The Experience Learning Model (ExLM) containing ESD can train students to understand real world problems holistically from an environmental, economic and social perspective. Students' ESD core competencies can create a sense of responsibility, and increase their confidence in their analytical skills and intention to act responsibly (Hung et al., 2023). From real experiential learning activities on ecological material,

students become critical characters and have IPs competency so they can take an important role as members of a sustainable global society.

Keywords: Experience Learning Model, ESD, Integrated Problem-solving Competency

ABS-ICMSCE-24204

Energy & Environmental Sustainability In The New Capital City of Indonesia: Voices of Junior High School Student

Alya Puspita Zahra, Greny Mispi Anisa Sari, Nurul Fitriyah Sulaeman, Shelly Efwinda, Atin Nuryadin
Mulawarman University

alyazahra2608@gmail.com, Grennysari@gmail.com,
nurul.fitriyah@fkip.unmul.ac.id,
shelly.efwinda@fkip.unmul.ac.id
atin.nuryadin@fkip.unmul.ac.id

Facing global challenges related to energy and environmental issues highlights the importance of the education sector playing its role in preserving the planet for future generations. Exploring students perspectives on energy and the environment aligned with education for Sustainable Development Goals (SDGs) is crucial, as it helps shape positive behaviors towards the environment and energy conservation. Focusing on the perceptions of students around Indonesia's new capital city (IKN) is crucial, as they are the future leaders who will impact the sustainability and development of the city. Understanding

their views and voices on energy and the environment can help in designing relevant and effective environmental education programs and policies to protect and preserve the environment in IKN. In this study, 400 junior high school students from three regions around IKN participated, including Penajam Paser Utara Regency (PPU), Kutai Kartanegara Regency, and Samarinda City. Through a questionnaire consisting of 17 questions, this study explored students perceptions of the energy and environment dimensions based on the SDGs. The results showed that students perceptions were generally at a moderate level. This study underscores the important role of education in introducing, raising awareness and understanding of energy and environment related to the SDGs by linking learning with development issues.

Keywords: Perception, Sustainable Development Goals (SDGs), Energy, Environment, New Capital City

ABS-ICMSCE-24206

**Analyzing teachers' effectiveness in Integrating
Education for Sustainable Development (ESD) on the
Classification of Living Things topic**

Ayu Nursalamah
Universitas Pendidikan Indonesia
ayunursalamah@upi.edu

Education for Sustainable Development (ESD) has begun to be implemented in Indonesian schools in order to achieve the Sustainable Development Goals (SDGs), especially in science education. This research was conducted to analyze a teachers' effectiveness in integrating Education for Sustainable Development (ESD) principles into a science lesson on the classification of living things topic. This research was conducted using a descriptive method. The 7th grade class of junior high school is the subject of the classroom observation. The instrument rubric for assessing the teacher's competencies to teach ESD was a validated instrument developed by Eliyawati et al. (2023). The key three areas of the instruments are divided into three: planning, implementation, and evaluation. Additionally, to support the analysis of the alignment of ESD principles, triangulation data was observed. Teaching artifacts (lesson plans, worksheets, and assessments) and teaching video recordings were also analyzed. The analysis of the data shows a well-structured curriculum, indicating strong alignment with ESD principles. However, the implementation application showed some variation, suggesting potential areas for improvement. Assessment design might not fully capture students' understanding of

sustainability concepts within the classification of living things topic. These findings highlight the importance of all phases of the learning process (planning, implementation, and evaluation) for effective ESD integration in science education.

Keywords: ESD, science education, school, teaching, classification of living things

ABS-ICMSCE-24207

Preliminary study: Application of Education for Sustainable Development in Chemistry Learning on the topic of extraction of anthocyanin compounds from red dragon fruit peel as a natural food coloring

Anis Muyassaroh, Asep Supriatna, Hernani
UNIVERSITAS PENDIDIKAN INDONESIA
anismuyassaroh99@upi.edu, aasupri@upi.edu,
hernani@upi.edu

Household waste, especially kitchen waste, has become an increasingly worrying environmental problem. The waste can pollute the environment and have negative effects on human health. Therefore, effective and proper management of kitchen waste is necessary. One type of kitchen waste is fruit peels. Utilizing fruit peel waste to produce natural colorants can help reduce the amount of organic waste dumped into the environment, improve the economy by turning waste into a useful resource, and provide a sustainable solution for healthy food. The purpose of this study is to determine whether the topic of

anthocyanin extraction from red dragon fruit peel as a natural dye can be in line with ESD principles and can be applied in the chemistry learning of prospective teacher students. This study used a quantitative approach using a descriptive method. The sampling technique used a random sampling technique. Data collection was done through questionnaires distributed to 32 students as respondents. The results showed that: (1) 66.7% of students strongly agreed and 22.2% agreed that the topic of separating anthocyanin pigments from fruit peels as natural dyes is an interesting context to be applied in chemistry learning, (2) 63.9% of students strongly agreed and 30.6% agreed that learning about the extraction of anthocyanin pigments used as natural dyes is relevant to current environmental issues, (3) 58.3% of students agreed and 41.7% strongly agreed that the use of anthocyanin pigment extracts from fruit peels as natural dyes can contribute to the achievement of SDGs. The implication of this research is to increase students' understanding of chemical separation in natural materials and develop the utilization of fruit peel pigments as an effective and environmentally friendly alternative. This research is expected to increase public awareness of the importance of using environmentally friendly natural dyes, as well as contribute to the development of chemistry learning by turning waste into environmentally friendly products.

Keywords: Natural Dye, Anthocyanin, Waste Fruit Peel

ABS-ICMSCE-24209
**The Analysis of ESD-Based Science Learning on
Human Circulatory System Diseases Topic for Junior
High School Students**
Faza Alika Sari Maudina
Universitas Pendidikan Indonesia
fazaalikasm@upi.edu

Science teachers must provide effective science instructions to achieve students' specific pedagogical goals and objectives in sustainable education. This research attempts to analyze the teaching practice of ESD-based science learning with the topic "Human Circulatory System Diseases" that focus on identifying the planning, implementation, evaluation and assessment aspects of teaching. The data were collected from the teaching module, lesson plan, worksheet and assessment consisting of ESD contents developed by the teacher. There were also class observations to assess three aspects in teaching ESD-based science learning: (1) Planning; (2) Implementation; and (3) Evaluation and Assessment. There were 26 grade eight junior high school students that were involved in this research. The research results showed that the teacher successfully designed and executed teaching and learning processes in a classroom to build understanding and awareness of ESD to the students. But the evaluation still needs some improvements in order to foster students' critical thinking skills.

Keywords: education for sustainable development (ESD), science education, junior high school

ABS-ICMSCE-24216

**From Taxonomy to Sustainability: Utilizing
Articulate Storyline Platform in Middle School
Science**

Rephiany Nur Afifah, Khalifatulloh Fiel'ardh, R. Ading
Pramadi, Iwan Ridwan Yusup

Universitas Islam Negeri Sunan Gunung Djati Bandung
rephianyna@gmail.com

Biodiversity is a critical topic within the framework of Education for Sustainable Development (ESD), aiming to foster awareness and understanding of the interconnectedness of natural systems and human impact. However, traditional school science curricula often focus narrowly on taxonomy, the classification of living organisms, without adequately connecting this knowledge to broader sustainability issues. This study addresses this gap by incorporating the Articulate Storyline platform to contextualize taxonomy within sustainability issues for middle school students in Bandung (N = 60). One class of students (n = 30) served as the control group, receiving traditional taxonomy instruction. The other class (n = 30) comprised the experimental group, receiving the storytelling-based intervention. The intervention comprised three lessons: (1) taxonomy in agriculture, highlighting the importance of classifying crop species for sustainable farming; (2) taxonomy of harmful mold and beneficial algae, emphasizing the role of microorganisms in ecosystems and human health; and (3) taxonomy of ornamental plants and common livestock, exploring the diversity of species used for food and decoration. Following the intervention, a questionnaire assessing both

conceptual mastery and student attitudes towards the material was administered. The experimental group ($M = 78.7$, $SD = 8.9$) demonstrated a significantly higher level of conceptual mastery compared to the control group ($M = 65.3$, $SD = 10.2$), $t(58) = -4.23$, $p < .001$, Cohen's $d = 1.09$. Additionally, the questionnaire responses revealed a positive attitude towards the storytelling-based approach, suggesting that this method enhanced their understanding and appreciation of biodiversity and its relevance to sustainability.

Keywords: Articulate Storyline, Middle School Science, Taxonomy, Biodiversity

ABS-ICMSCE-24218
**Development of Food Literacy Co-curricular
Program in School for Primary School Student in
Phase A (Grades 1 & 2)**

Haura Dzakira Sahla
Pengembangan Kurikulum, FIP, UPI
hauradzakiras@upi.edu

Food skills are often considered to be an underrated part of school education, especially at the elementary school level in Indonesia. In fact, skills in food literacy are very important to support students' health in the current growth period and also in the future. Apart from that, to achieve the second SDG goal, the second target, namely ending all forms of malnutrition in children aged toddlers to teenagers, can also be achieved through the role of

education that cares about increasing good food literacy in schools. This research aims to develop a co-curricular program design with a food literacy perspective for elementary school students especially in ‘phase A’ students (primary grades 1 & 2) using the ADDIE model as a research and development model. The result of this research is a co-curricular program design that has a food literacy perspective and is recommended for implementation in Phase A elementary school improvements.

Keywords: food literacy, curriculum development, co-curricular, SDG's

ABS-ICMSCE-24220

Development of Local Wisdom Based-Module “Batik Tulis Tanjung Bumi Madura” to Support Education for Sustainable Development (ESD)

Wiwin Puspita Hadi, Aida Fikriyah, Faizatul Holidiah
Universitas Trunojoyo Madura
wiwin.puspitahadi@trunojoyo.ac.id,
aida.fikriyah@trunojoyo.ac.id, faizahdiah17@gmail.com

The aims of this research was to describe and produce teaching materials using the local wisdom context of batik tulis Tanjung Bumi Madura to support the achievement of ESD as part of the Sustainable Development Goals (SDGs). This type of research is development using the ADDIE development model. The subjects of this study were students of the school MTsN Bangkalan and at

SMPN 1 Tanjung Bumi Bangkalan East Java Indonesia. The results showed that the development of the ESD content module includes cultural diversity, poverty reduction and natural resources which are associated with the batik making process with feasibility aspect of media and content respectively 91.07% and 92.5% and a very decent criteria. The module developed is also practical with a student response and readability respectively 81.47% and 78.44% with very good information. Based on these results, it is known that the module integrated with local wisdom on the Tanjung Bumi batik theme to support education for Sustainable Development (ESD) is suitable for application in learning

Keywords: Module, Local Wisdom, Batik Tulis, Tanjung Bumi, Education for Sustainable Development

ABS-ICMSCE-24232

A Decade of Teacher Training Trends on Education for Sustainable Development (ESD): A Systematic Literature Network Analysis

eliyawati eliyawati, Ari Widodo, Ida Kaniawati, Hiroki

Fujii

Universitas Pendidikan Indonesia

eliyawati@upi.edu, widodo@upi.edu,

kaniawati@upi.edu, fujii-hi@okayama-u.ac.jp

Education for sustainable development (ESD) is needed as the way to achieved Sustainable Development Goals (SDGs). The emergence of ESD into the school

curriculum is crucial to engage students in a more sustainable lifestyle. However, teachers do not have sufficient knowledge to implement the ESD in their teaching-learning. Therefore, the teacher training programs must improve the teachers' competence in integrating ESD. This study attempts to identify the state-of-the-art mapping, the emerging trends topics, and the future work of Teacher Training on ESD research. The method used in this research is systematic literature network analysis (SLNA), which combines systematic literature review and bibliometric analysis. The article from the last ten years was analyzed through several steps: identification, screening, eligibility, and SLNA. Open Refine, VOSviewer, and Biblioshiny by Bibliometric are software and applications utilized in SLNA. The result shows that the most sources from the sustainability journal and the most relevant author is Baena Morales. The trending topics are still in environmental education as a subject for integrating ESD through teacher training. Future works for bridging the ESD into some workshop or teacher training focus on classroom practices, improving the teacher's competence for delivering ESD in their learning and focusing on actions associated with environmental education to achieve the SDGs. Some teachers' training on ESD can be used in future work as a foundation for teacher professional development.

Keywords: Education for Sustainable Development; Systematic Literature Network Analysis; Teacher Training.

ABS-ICMSCE-24236

The Analysis of ESD-Based Science Learning in the Classification of Living Things Topic for Junior High School Students.

Khaliza Annisa Zain

Universitas Pendidikan Indonesia

khalizaann@gmail.com

This research aims to analyze education for sustainable development (ESD)-based science learning processes in a classification of living things class, starting from planning, implementation, until evaluation. The class consists of thirty three students of Junior High School level. The analysis included pedagogical content knowledge, inquiry, professional practice, evaluation and assessment. The result shows that all stages, that is planning, implementation, and evaluation, utilize the value of sustainability, it begins with the understanding, awareness, then action as a sustainability lifestyle. Implementation stage got the highest score compared to the planning and evaluation stage. As a result, professional practice in the implementation stage applies most outstandingly in the class with a score of zero point eight, while inquiry only zero point seven although three fundamental pillars of sustainable development, that is social, economic, and environmental, are always mentioned and used to stimulate their problem solving skill in the class. However, in terms of action, there is an activity in order to ensure that the value of sustainability does not end in the classroom. Moreover, pedagogical content knowledge, evaluation, and assessment perform well with a score that close to zero point eight. This study

is expected to be a starting point for developing ESD-based learning, not only at the junior high school level, but also at all levels of education.

Keywords: ESD, Junior High School, Sustainability,

ABS-ICMSCE-24254

High School Students' Understanding of the Sustainability Consciousness of Development Goals

Samudra Mutiara Hasanah, Prof. Dra. Sri Rahayu, M. Ed., Ph.D, Dr. Oktavia Sulistina, S.Pd., M.Pd., Devi Mariya Sulfa, S.Pd.

Universitas Negeri Malang

samudra.mutiara.2303318@students.um.ac.id

Nowadays, the awareness of Sustainable Development Goals (SDGs) is a growing issue in high school curricula. Sustainability Consciousness (SC) is a variable output of the understanding of SDGs that has three domains: cognitive, socio-emotional, and behavioral. Previous studies have developed instruments for SC, but are limited to the student level of prospective teachers. The study aims to find out the level of SC students related to the understanding of the SDGs at the secondary school level which is also a crucial aspect in achieving the understanding. The study uses quantitative research methods through a survey of 117 students from 28 high schools in East Java. A questionnaire-shaped research instrument consisting of 30 items based on a Likert scale. The SC level profile of the survey results suggests that

most of the students' understanding of the SDGs is at the primary and intermediate levels. This research can provide empirical evidence of the level of awareness of the SDGs among high school students and as a preliminary study related to the sustainability consciousness of students. The recommendation for further research is related to the understanding of SDGs on specific material to know SC profile specifically.

Keywords: Development Goals, High School Students, Sustainability Consciousness, Survey

ABS-ICMSCE-24255

Sustainability Literacy Profile of Secondary School Students: A Survey to Initiate Sustainability Education through STEM-Integrated Biology Instruction

Refsya Aulia Fikri

Universitas Negeri Malang

refsya.aulia.2203419@students.um.ac.id

This study looked at the sustainability literacy profile of high school students and saw opportunities for implementing STEM-integrated biology instruction as a facility implementing environmentally sound Education for Sustainability (EfS). Incorporating sustainability into school curricula is crucial because it's a pressing world issue. Data from the cohort of high school students enrolled in this study amounted to 246 respondents from 6 high schools. This study used a mixed-method

methodology. With qualitative research examining how students perceive and understand sustainability ideas through semi-open-ended question tests, the quantitative analysis evaluates students' sustainability literacy skills according to preliminary data. Increased student sustainability knowledge and STEM-integrated biology instruction correlate positively. The nuanced findings highlight the need for additional pedagogical enhancements to enhance students' understanding and engagement with the principles of sustainability that are urgently applied, especially concerning the environment. The study highlights the importance of STEM-integrated approaches in increasing environmentally conscious citizens and adds to ongoing discussions about adopting EfS. These results are subject to consideration and continued research to develop comprehensive learning on Biology-STEM and EfS in secondary schools. This study also contributes to the ongoing discourse on EfS implementation and underscores the role of STEM-integrated approaches in nurturing environmentally conscious citizens.

Keywords: Biology Education, STEM Education, Sustainability Literacy, Secondary School,

ABS-ICMSCE-24260
**Potential of Wind Power Energy Projects in
Mountainous Regions of Indonesia: A Literature
Review**

Widia Widia, Ida Kaniawati, Lilik Hasanah, Eka Cahya
Prima

Universitas Pendidikan Indonesia
widia22@upi.edu

The Indonesian government has set 17 SDGs by 2030, one of which is ensuring that clean and affordable energy is accessible to all. The aim of this research is to examine the results of reviews and investigations regarding the use of wind as renewable energy projects among students in the last 10 years. The research methodology consists of four different phases, namely research design, “filter methodology”, online database data search, inclusion and exclusion criteria, and data analysis. The results of Scopus document analysis in the last 10 years (2013-2023) show that there is a lot of research on wind power generation as an alternative energy, with around 11,925 documents originating from 248 countries. The countries that have done the most research on wind power energy in the last 10 years are China with 1866 documents and the United States with 1838, while Indonesia only contributed 253 documents. Overall, the research discusses wind potential and its use as well as several windmill designs. However, no one has specifically linked it to the learning process, let alone ESD-based learning, the results of which can then be used directly by the community, especially to train creative thinking skills and sustainable awareness.

Keywords: Wind Power Energy, Potential in Indonesia, Project, Literature Review

ABS-ICMSCE-24099

Importance of Teacher Training in Disasters Prone Area: A Case Study on Teacher Training Program for Disaster Prevention Education in Central Java

TUSWADI -, Takehiro HAYASHI

SMP NEGERI 1 BANJARNEGARA

tus5800@yahoo.com, wakupro@icloud.com

We have implemented the teacher training program on 12 June 2019 in Banjarnegara in Central Java, aiming to heighten teacher's knowledge and teaching abilities on disaster prevention. Total of 65 teachers participated in the training program, with a wide range of ages, schools, major subjects, and teaching experience. For investigating those teacher's awareness relating to disaster prevention education and evaluating the effectiveness of the training program, both pre- and post-questionnaires surveys were conducted. The pre-questionnaire consisted of selecting 3 items from 11 items by severity order. The dominant answer for problems in daily disaster prevention education was "pupils' low interest in disaster prevention", in which 20% of them answered "very severe" and 13% "severe", respectively. The subdominant answer was "difficulty for pupils to get knowledge about disaster prevention," in which 17% of them answered "very severe", 6% "severe," respectively. The training program included two activities: one was explanation on mechanism and feature of natural disasters focusing on landslide and volcanic eruption which frequently occur to many areas in Indonesia; another was

provides experiments relating to water flow with using the model developed by the authors.

The post-questionnaire was about the effectiveness of the training program. The result for the heightening teachers' knowledge about the mechanism and feature of disasters, 36% of the teachers answered "strongly effective" and 63% "some effective," respectively. On the structure of the training program, 36% of them answered "strongly effective" and 62% some effective. On the experiments, 45% of them answered strongly effective and 52% some effective, respectively. Based on these research findings, we regard the training program was meaningful not only for increasing teachers' knowledge about disasters but also for heightening their ability to teach disaster prevention classes.

Keywords: teacher training, disaster prevention, knowledge, attitude, teaching abilities

ABS-ICMSCE-24003

Examining pre-service teachers' perceptions of diverse learners in science teaching

Shingo Uchinokura, Taito Yuge, Hiroaki Suzuki

Kagoshima University

uchinokura@edu.kagoshima-u.ac.jp,

k1566167@kadai.jp, hsuzuki@e.yamagata-u.ac.jp

A better understanding of learners is essential to teachers' pedagogical knowledge, without which science teachers cannot undertake responsive teaching to diverse learners, ultimately ensuing social justice in science classrooms. This study examined pre-service teachers' perceptions of diverse learners in science teaching via an online questionnaire. Participants comprised 269 pre-service teachers (112 men, 153 women, and 4 unspecified) from two national universities in Japan. Some of the students were in the course of primary school teachers, others were in the course of secondary science teachers. They answered questions about teaching science to diverse learners including gender, economically disadvantaged students, students in rural areas, students with limited Japanese proficiency, students with disabilities, and gifted/talented students. Pre-service teachers had clearer ideas of boys and girls compared to economically disadvantaged students and those in rural areas. Both female and male pre-service teachers indicated that boys were more engaging in science learning than girls. This perception was shared by the pre-service teachers in primary and secondary school courses. However, they did

not support the idea that active educational intervention in science classrooms is needed to enhance student science competence. It was the same for students with limited Japanese proficiency. However, for students with disabilities and gifted/talented students, they considered active educational intervention as essential. These results indicated that pre-service teachers recognised diverse learners in current science classrooms, but had limited knowledge about these learners and responsive teachings in diverse situations. Thus, including pedagogies for diverse learners in science teaching method courses is recommended.

Keywords: pedagogical knowledge, pre-service teachers' perceptions, diverse learners, responsive teaching

ABS-ICMSCE-24009

Parental emotional support on adolescents' attitudes toward science and science literacy: A comparison between Korea and the United States

Pey-Yan Liou, Ssu-Ching Huang, Eunjung Myoung,
Sufen Chen

Department of Education, Korea University
pyliou@korea.ac.kr, schuang0122@gmail.com,
ejmyoung@stanford.edu, sufchen@mail.ntust.edu.tw

This study examines the predictive effects of parental emotional support on adolescents' science literacy in two cultural settings, Korea and the United States. We were particularly interested in examining the roles of

adolescents' attitudes toward science on the effect of parental support on their science literacy. We conducted a moderated mediation analysis on data from the Programme of International Student Assessment from Korea (N= 5581) and the United States (N = 5712). The results indicated that parental emotional support significantly predicted adolescents' science literacy through the mediational mechanism of their attitude toward science. The patterns between parental emotional support and adolescents' science literacy were the opposite in the two countries. The relationship was positive in Korea but was negative in the United States. Moreover, the effect of parental emotional support on adolescents' intrinsic motivation was stronger in Korea than in the United States. The study's findings highlight the need to include adolescents' attitudes toward science to explain the effect of parental emotional support on their science performance. This cross-national comparison also sheds light on the cultural factor that played a role in the effects of parental emotional support on adolescents' attitudes and science literacy.

Keywords: Parental support, attitudes toward science, PISA, international comparisons

ABS-ICMSCE-24032

Integration of teacher training and in-service teacher education for elementary school science teachers

Hiroaki Suzuki, MINA GOTO

Yamagata University

hsuzuki@e.yamagata-u.ac.jp, goto@e.yamagata-u.ac.jp

The need for elementary school teachers to possess professional qualifications and abilities in science has increased. This study aims to develop an educational program that enhances teachers' professional qualities and abilities in elementary school science. The program integrates part of Yamagata University's teacher training program with part of Yamagata Prefecture's in-service teacher training program. Yamagata University, Yamagata Prefecture, and the Yamagata City Board of Education collaborated to form a consortium for teacher training. Together, they intended to develop courses to cultivate the professional qualities and abilities of elementary school science teachers, primarily in Yamagata Prefecture, and establish an educational program (certification system) to evaluate and certify the qualities and abilities of trained teachers. This program confers the qualification of “Science Meister” on those who complete a certain number of courses. The educational program consists of four themes: “programming education,” “fieldwork,” “science lab managements,” and “science lesson study.” These signify the most pressing issues in Japan. The program began in FY 2018 and had 375 participants through FY 2023. Of these, 14 participants completed who all educational programs and became “Science Meisters.” The

integration of the educational program facilitated identification and support of the professional qualities and abilities of elementary school science teachers.

Keywords: Science Teacher Education, Elementary School Teacher Training, Integration of Teacher Training.

ABS-ICMSCE-24010

**Development of a Board Game for Teaching
Concepts in Carbon Footprint**

Lowell Gabunilas, Jerald S. Galgao, Cyra Nicole A.

Imbong, Rejoice C. Apdian, Shandy P. Balagulan

University of San Carlos

lowell.gabunilas@ustp.edu.ph,

sjeraldgalgao@gmail.com

In accordance with the 13th sustainable development goal of the United Nations, integrating climate education across all levels is a key step toward raising awareness and empowering the population to take meaningful action to mitigate the far-reaching consequences of climate change. Climate and ecosystems are major contents in the Philippine basic science education curriculum, which emphasizes developing competencies related to minimizing human impact on the environment, informing the design and implementation of strategies for teaching associated lessons. In this paper, we present the development of a board game prototype for teaching about carbon footprint, which is an important topic in

climate education. The development of the board game, My Journey to a Sustainable Life, is anchored on theories in learning and game design, and specific content standards in the Philippine K to 12 Curriculum. Using descriptive research, the game design, game mechanics, appropriateness as instructional material, and perceptions of the use of the board game were determined. Results show that the board game's design, game mechanics, and appropriateness as instructional material are positively received by the evaluators, implying its suitability for use in the classroom. Furthermore, user testing reported an overall enjoyable gaming experience among the participants. Investigations into the board game's impact on student performance in actual classroom deployment are recommended.

Keywords: game development, educational game, board game, science education, climate action

ABS-ICMSCE-24018
**Using Virtual Laboratory Perception of Pre-Service
Teacher in Inquiry Learning for Fostering Scientific
Process Skills**

Siti Fatimah, Muhamad Chamdani, Khaerus Syahidi
Universitas Negeri Semarang
sitifatimah2023@students.unnes.ac.id,
muhamad_chamdani@staff.uns.ac.id,
khaerussyahidi@gmail.com

This study aims to determine the perceptions of elementary school teacher candidates in the use of virtual laboratory in inquiry-based learning as a tool to support scientific process skills. This research is a survey conducted on 112 elementary school teacher candidates. Data collection techniques used questionnaires. Data analysis used quantitative descriptive analysis. The results show that the perceptions of elementary school teacher candidates towards virtual laboratory in supporting scientific process skills show a high level of satisfaction. 87% of students believe that the virtual laboratory is supported by very clear instructions and explanations. Virtual laboratories also serve as a good recommendation due to the lack of laboratory facilities. The scientific process skills of elementary school teacher candidates after using virtual laboratory are good. They can control variables present in the virtual lab, thus being able to explore existing scientific concepts.

Keywords: perception, virtual laboratory, inquiry, scientific process skills

ABS-ICMSCE-24031

**The Impact of Integrating Subcultural Materials into
CLIL-Based Bilingual Science Courses on Students'
Scientific Reasoning Skills**

Yu-Ling Lu, Chih-Ai Yeh

Department of Science Education, National Taipei

University of Education

yllu@tea.ntue.edu.tw, melody8352@gmail.com

This study aims to explore the impact of integrating subculture teaching materials such as "board games" and "e-books" into bilingual instruction on students' bilingual learning of scientific reasoning abilities. The research adopts a quasi-experimental research design, with third-grade students from a primary school in Taipei City as the research participants, focusing on the teaching content of "weather" and "animals" units. The experimental group(n=25) receives CLIL bilingual instructional activities that integrate subculture teaching materials, including board games and e-books. Scientific english vocabulary instruction is conducted through board games, followed by nurturing bilingual scientific concepts and scientific reasoning through e-books. The control group(n=24) only undergoes CLIL bilingual instructional activities. The instructional period is 8 weeks, with 3 classes per week. The research assessment instrument is a "scientific reasoning ability" test, which has been validated through internal consistency analysis and expert content validity testing, demonstrating good reliability and validity. Both groups of students are assessed using the "scientific reasoning ability" test before and after the instruction. The research data analysis included

descriptive statistics, t-tests, and one-way ANCOVA to analyze the data, aiming to understand whether there are differences in the cultivation effectiveness of scientific reasoning abilities between two groups. The analysis led to the following conclusions:

1. Students who received teaching integrated with "board games" and "e-books", as well as those who received pure CLIL teaching, showed significant improvement in their "Scientific Reasoning Ability" after the instruction.
2. In terms of "Scientific Reasoning Ability," the performance of students who received instruction integrated with "board games" and "e-books" was significantly better than that of the students in the pure CLIL group.

Keywords: bilingual science, scientific reasoning, subculture

ABS-ICMSCE-24036

The process of planning an experiment by children

Yoichiro Abe, Tomohiro Arai, Daiki Mukai, Toyosei Hirata

Hyogo University
abe@hyogo-dai.ac.jp

The purpose of this study was to characterize the process by which children plan experiments in elementary school science classes. In Japan science education, it is important for learners to form hypotheses and plan experiments. Prior research had shown that the reasoning structure of

experiment planning is a process of extracting ideas about intervention and measurement from the explanatory hypothesis and embodying each of them. Therefore, we set up a situation in which elementary school students plan experiments on aqueous solutions in an elementary school science class, and analyzed the differences among the 11 experiments planned by the children in terms of intervention, measurement, and embodiment. We also classified the utterances of the situations in which children planned experiments from the same perspectives. The results of the analysis revealed that the experiments planned by the children were not single but diverse, with several experiments planned with different working hypotheses, experimental methods, and concrete operations. It also became clear that the discussions proceeded back and forth from abstract working hypotheses to concrete experimental manipulations, and that the process was complex rather than simple.

Keywords: planning experiment. hypotheses

ABS-ICMSCE-24037

Characteristics of the tasks in Japan’s science textbooks: Focusing on the chapter “Science, Technology and Humans”

Kousuke Shimada, Yusei Nomura, Tetsuo Isozaki
Hiroshima University Graduate School of Humanities
and Social Sciences

k-shimada@hiroshima-u.ac.jp, d230385@hiroshima-
u.ac.jp, isozaki@hiroshima-u.ac.jp

Research on the teaching and learning of nature of science (NOS) has advocated “explicit-reflective” and “context” approaches, which have been widely accepted as effective strategies. However, although it is important to understand the NOS, the national curriculum for science in Japan does not explicitly address it. Therefore, further theoretical and empirical insights are needed that consider the educational context of Japan when implementing NOS instruction. In this study, we focused on tasks related to the “explicit-reflective” approach in the science textbooks. For example, open tasks can help students understand “science in the making” as a part of NOS and allow them to conduct planning practical work or make a decision on socio-scientific issues. Thus, this study aimed to investigate tasks in Japan’s science textbooks in Grade 9. We analyzed tasks in the chapter “Science, Technology and Humans,” which addresses the relationship between science and daily life, promotes environmental education to encourage students’ interests, and conveys the importance of a sustainable society. It was expected that this chapter would include a number of open tasks. The results showed that the ratio of open tasks in this chapter

was more than one quarter. Furthermore, the diversity of tasks varied across different sections. There were no open tasks in the section on ecosystems and no open tasks of evaluation in the section on plastics, whereas the other sections contained all types of tasks. Based on these findings, we argue that it is necessary to develop science textbooks and design appropriate teaching strategies.

Keywords: Nature of Science, textbook analysis, task

ABS-ICMSCE-24038

From biology to technology: A narrative study of a non-specialist teacher's teaching beliefs and approaches in Taiwan's new technology curriculum

Hsin Chen, Meichun Lydia Wen

National Changhua University of Education

d0721004@gm.ncue.edu.tw, mlwen@cc.ncue.edu.tw

In Taiwan's new curriculum guidelines, the "Technology Discipline" was introduced for the first time in 2019. In response to the shortage of qualified technology teachers, many non-specialist teachers engaged in teaching this subject. This study used narrative research methodology, interviews, classroom observations, and instructional materials to explore the teaching beliefs of a biology teacher in a technology course. The teacher developed a unique approach to curriculum development, integrating interdisciplinary ideas and a task-oriented thematic model based on the stages of experience, emotion, and action. Beginning with observations of accessible biological

subjects, he incorporated the inquiry-based learning cycle focused on tacit knowledge, essential in practice-based technology education. He believed that traditional teaching methods encapsulated knowledge in a rigid shell that students struggled to internalize. Thus, he converted tacit knowledge into explicit forms, empathetically making it tangible for students. His teaching belief was rooted in a deep passion for science and experiences from science teacher training, supported by both the school community and external resources, which enhanced his professional development. Continuously striving to understand and encourage his students' exploration, he attempted to harmonize teaching ideals, content delivery, and student achievement. Researchers concluded that there was a significant correlation between his scientific background and his ability to integrate these beliefs into his teaching of technology subjects, effectively aligning curriculum construction with his teaching beliefs. Findings suggest further research into similar adaptations across different disciplines to optimize educational reforms.

Keywords: narrative research, teaching belief, technology curriculum

ABS-ICMSCE-24042
**The Effect of Promoting Empathic Behavior on
Cooperation in Reciprocal Teaching of Elementary
School Science**

Yasunari Hayashi, Fumiko Okiharu
Graduate School of Science, Tokyo University of
Science
y-hayashi@yamanashi-ken.ac.jp,

This study examined the effect of an intervention promoting empathic behavior on learners' cooperation in reciprocal teaching during an elementary school science lesson. Two sixth-grade classes (66 students) in elementary school were taught the same science lesson by same teacher, but one class received an intervention to promote empathic behavior and the other did not. In the intervention class, cards with example conversations (that would indicate agreement with questions) were distributed during activities in which students explained natural phenomena to each other in groups. In the control class, the teacher did not distribute example conversation cards for the group activities but did encourage students to use empathic behavior during the groupwork. The results showed that the scores on the cooperativeness questionnaire improved more in the intervention class than in the control class; more cooperative utterances also appeared during class for the intervention group. These results suggest that promoting empathic behavior among questioners in class can improve cooperation by promoting overall empathic behavior and encouraging effective utterances.

Keywords: science class, reciprocal teaching, empathic behavior

ABS-ICMSCE-24060

Exploring Teacher Agency Research: A Systematic Review

Eun-Jeong Kim, Myeong-Kyeong Shin
Gyeongin National University of Education
ejkim508@gmail.com, mkshin@ginue.ac.kr

In education field, the quality of teachers has a significant role in students' learning. In the same side, exploring teacher agency in this context has been focused on by researchers. The purpose of this paper is to review the science education studies during the period of 2019-2023 related to teacher agency, and to suggest the possible teacher agency model for the further study. 16 peer-reviewed articles were analyzed qualitatively based on the three aspects; context of the research, source of data, and the model of agency. First, context of the research refers to location and the grade levels of the teachers in this study. Second, sources of data collected in reviewed articles were identified three types of them: interviews, observations, and artifacts. Lastly, three types of agency model were explored in those reviewed articles: shared theorization, specific to the paper theorizations, and unexplicated agency.

Keywords: teacher agency, science education, model

ABS-ICMSCE-24063

**Collegial counseling in science teacher training using
the example of lesson studies**

Melina Doil

Carl von Ossietzky Universität Oldenburg
melina.doil@uni-oldenburg.de

In German science teacher training, skills such as reflecting and evaluating teaching are considered as essential components of practice-oriented education [1]. However, the targeted promotion of these skills decreases significantly as science teachers enter the profession [2]. In contrast, teacher training in Japan is characterized by the early involvement of prospective teachers and the continuous engagement of teachers in collegial consultation. In recent years, the importance of peer consultation as a tool for the continuous improvement of teaching and the professional development of teachers has been recognized worldwide. The lesson studies practiced in Japan have proven to be a high-quality, cost-effective, and time-saving opportunity for further training, allowing teachers to develop professionally and personally through peer counselling [3]. Due to their diverse possibilities, lesson studies also offer interesting starting points for German teacher training, but these need to be established accordingly. To this end, the structural requirements of both teacher training systems are first analysed. Due to language barriers, English-language descriptions of the Japanese system are primarily used. A more in-depth analysis is then planned with Japanese colleagues. In addition, a pilot study will be conducted to determine the interest of German science

teachers in low-threshold further training courses. Based on the results obtained in this way, approaches for a practical pilot phase to establish lesson studies as a further training measure in Germany will then be outlined. The presentation will focus on the challenges and opportunities that arise when integrating Lesson Studies into German science teacher education. It will emphasize the opportunity to learn from Japanese colleagues and integrate their experiences into the development of German science teacher education.

Keywords: Science teacher training, Lesson Study, Collegial counseling

ABS-ICMSCE-24064

Traditional Games-based Differentiated Science Learning Book

Dwi Septiana Sari, Yeni Widiyawati, Ina Sholihah Widiati

Science Education Programme, Science and Technology Faculty, Ivet University
saridwiseptiana@gmail.com,
yeni.widiyawati26@gmail.com,

The development of the curriculum and the diverse characteristics of students in the classroom require teachers to have the competence and skills to design and manage learning. However, facts in the field show that science teachers' understanding of differentiated

instruction in the Merdeka curriculum is still lacking. Therefore, supporting books are needed to facilitate teachers in understanding differentiated instruction, ethnoscience, and transitional games in learning. This research aims to determine the feasibility of a differentiated science learning book based on traditional games that have been developed. This research adapts the Borg and Gall research and development model. The research instruments used were expert validation sheets and interview guide sheets. The data analysis technique used is quantitative-descriptive. Based on expert validation, the results of the feasibility analysis showed 93.75% (valid) in the didactic aspect; 83.93% (valid) for construction aspects; and 83.33% (valid) in the technical aspect. The book contains the basic concepts of differentiated instruction, the role of technology in learning, as well as the concept of ethnoscience in science, namely raising the topic of Sunda Manda, Engklek, and Egrang Batok Kelapa games. The integration of traditional games in learning science material supports the introduction of local wisdom, and student understanding, and enables student-centered learning by paying attention to differences in student learning styles, namely the kinesthetic learning style. Therefore, traditional games-based differentiated science learning books are suitable for use as teachers' guidelines in designing differentiated science learning.

Keywords: Differentiated instruction, science learning book, traditional games, merdeka curriculum

ABS-ICMSCE-24065

**The Development of Power Plant Board Game to
Raise the Environmental Awareness for Elementary
Students**

Saowaluk Poommarin, Witat Fakcharoenphol
Kasetsart University
saowalukpoommarin1396@gmail.com,
witatmak@gmail.com

This study aims to develop Power Plant Board Game to raise the environmental awareness and to investigate the flow experience of the board game designed for eighth-grade students. Through qualitative interviews, students' immersion and engagement during gameplay were examined. Results reveal that students experienced flow, characterized by deep concentration, enjoyment, and challenge. Factors contributing to flow included clear goals, immediate feedback, and an appropriate balance of skill and challenge. The study found a positive correlation between flow states and learning achievement, emphasizing the potential of immersive gaming experiences to enhance education.

Keywords: Educational Game, Flow, Environmental Awareness

ABS-ICMSCE-24066
**Development and Validation of a Test for Exploring
Middle School Students' Empathetic Problem-
Solving Ability**

Kusumar Ubonmoung, Tussatrin Wannagatesiri
Kasetsart university
aomam.725@gmail.com, tussatrin.k@ku.th

This study aims to create the Empathetic Problem-Solving Ability Test (EPSA) to evaluate middle school students' ability to solve problems empathetically. Middle school students (n=10) were individually interviewed through the 4 different context-rich problems. Each problem concerns environmental context related to current local public issues. The data obtained from the interview were scrutinized to pinpoint the precise scores on the Rubric that indicate empathetic problem-solving abilities. The interview questions and their context-rich were transformed to be written form. The content validity of the test was checked by three science educators. Then the EPSA test was administered to 40 eighth-grade students in Thailand. The data indicates that students do not possess adequate problem-solving skills. Most students tend to prioritize their own opinions and solutions, often disregarding the perspectives and needs of others that inform through the context of the question.

Keywords: empathetic problem-solving ability, middle school students, local public context problems

ABS-ICMSCE-24068

**Towards Goal 13 of Sustainable Development:
Indonesian Students' Perceptions of Global Warming**

Shelly Efwinda, Zeni Haryanto, Muliati Syam

Mulawarman University

shelly.efwinda@fkip.unmul.ac.id,

zeni.haryanto@fkip.unmul.ac.id,

muliati.syam@fkip.unmul.ac.id

Addressing climate change, including global warming, is one of the Sustainable Development Goals (SDGs). One of the factors that can influence individuals' actions to prevent global warming from worsening is their perception of the phenomenon. High school students' perceptions of global warming are essential to explore because they are the next generation who play an important role in maintaining the earth's sustainability. This study aims to explore high school students' perceptions regarding Global Warming. The participants in this study were 285 Indonesian high school students in grade X who were studying Global Warming. The research instrument used was a questionnaire with four questions with answer options and four open-ended questions. Data from the answers to 4 questions with answer options were processed with quantitative descriptive analysis by calculating percentages. Data from the answers to 4 open-ended questions were processed with qualitative descriptive analysis using KH-Coder. The results showed that most students believe that global warming has occurred and are worried about this phenomenon. They perceive that they have implemented a reasonably environmentally friendly lifestyle daily.

Regarding their perception of the level of knowledge about global warming, most of them think that they only know the basics. Based on these results, it is necessary to strengthen the positive, environmentally friendly actions that students have tried to do in their daily lives and make efforts to increase climate change education, including global warming, in schools and communities.

Keywords: Climate change, Global Warming, SDGs, Perceptions

ABS-ICMSCE-24076

A Systematic Review of Research Evidence of Differentiated Instruction in Indonesia's Science Education

Yeni Widiyawati, Dwi Septiana Sari, Ina Sholihah Widiati

Program Studi Pendidikan IPA, Fakultas Sains dan Teknologi, Universitas IVET

yeni.widiyawati26@gmail.com,

saridwiseptiana@gmail.com, inasholihahw@gmail.com

Differentiated instruction (DI) is a new challenge for teachers in Indonesia along with the implementation of the Independent Curriculum. Every student is unique and has their own learning demands. The main goal of science learning is to accommodate the diverse uniqueness of students to create equality and recognize individual differences. Even though DI has been proclaimed in curriculum policies and implemented by teachers, the

status of empirical evidence and its advantages in increasing student learning outcomes in science learning is not yet known. This paper aims to provide an overview of DI in Indonesia's science education as well as the previous research findings on its effectiveness. A rigorous and selective process was carried out to select articles published from 2020-2024 from journals indexed by the DOAJ, SINTA and SCOPUS databases. Selected papers were reviewed and narratively described. Because the number of research articles available is very limited, the conceptual portrait of differentiated science instruction in Indonesia cannot be described clearly enough. The articles discuss various things, including teachers' experiences, multiple intelligence towards DI; academic achievement and self-efficacy; DI attributes, instructional design, readiness and future implementation in science learning.

Keywords: Differentiated instruction, science education, independent curriculum, systematic review

ABS-ICMSCE-24080

**Students' and Teachers' Perceptions of Science
Lessons with ICT in Japan**

Ryugo Oshima, Oscar Muriithi

Chiba University

ryugo.oshima@chiba-u.jp, oscarmuriithi@gmail.com

This study presents a descriptive analysis of students' and teachers' perceptions of using ICT tools to establish their benefits in teaching and learning science. The population of this study consisted of 151 students in the first and second years (Y7 and Y8 students) and two science teachers of a lower secondary school in Chiba, Japan. Data was gathered via non-participant observation of science lessons, a questionnaire was administered to students, and interviews were conducted with the science teachers in the school. The research revealed that 97.3% of the respondents perceive themselves as actively using ICT in their science lessons. This can be attributed to the availability of ICT devices to each student and the readily available internet provided by the board of education in the city. Most students used their devices for basic functions such as displaying photos and playing videos related to the lesson, while document and presentation software were used less frequently. However, many of them used Google Classroom for submitting assignments and accessing learning materials. Despite this, majority of students found that using ICT for learning science was enjoyable and improved communication through collaboration with their classmates. Even with them limited to basic access only, many students indicated that they did not have

challenges like connectivity issues (50.6%), difficulty using the devices (68.4%) and not having enough time to use the ICT devices during the lessons (56.8%). The teachers, however, stated that the use of ICT in science education was yet to be put to the best use, indicating that they mostly dwelt on teaching through the traditional methods of chalkboard, lecture and experiments. They stated that this was because of a lack of proper guidelines on the range of use of ICT in the subject.

Keywords: Information and Communication Technology (ICT), Perceptions, traditional methods, Japan

ABS-ICMSCE-24086

Exploring the Nexus Between Students' Interests and Science Textbook Contents: Insights from Japanese Middle School Education

Soichiro Kudo, Mikiharu Ishitobi, Kodai Miura, Shotaro Naganuma, Daiki Nakamura, Hiroki Otani, Naoya Sakuma, Hideyuki Tanaka
Hiroshima University
soichiro.kudo.3160@gmail.com,
mikiharu822@gmail.com, kktays0520@gmail.com,
naganuma.shotaro.062@m.kyushu-u.ac.jp,
nakamura@cc.miyazaki-u.ac.jp, otanilh@otsuma.ac.jp,
sakuma.naoya.fu@un.tsukuba.ac.jp,
1722705@ed.tus.ac.jp

It is important to foster student's interest in science, and crucial to discuss how scientific topics are covered in

textbooks. In Japan, textbooks are legally required teaching materials, and are used by both teachers and students as the basis for learning and teaching. However, there is insufficient analysis of the relationship between the topics of interest to students and the contents of textbooks. We analyzed middle school science textbooks and data from the ROSES (Relevance of Science Education-Second) survey, which collected topic-level interests data from 3,417 Japanese 9th-grade students, to answer the following research questions: RQ1 “How are the topics indicated by ROSES items treated in textbooks”, RQ2 “What relationship exists between students’ interests and contents of textbooks?” The main results were as follows: (a) The topics indicated by ROSES items were mainly covered in the text, columns, and picture descriptions, (b) There was little difference in the level of interest based on whether the topic was in textbooks, (c) Topics covered as geoscience in textbooks were of higher interest. Furthermore, we categorized the 77 ROSES items into four groups based on the interest level and whether the topic was covered in textbooks; Group 1 (higher interest - covered; 42 items), Group 2 (higher interest - not covered; 17 items), Group 3 (lower interest - covered; 15 items), and Group 4 (lower interest - not covered; 3 items). We then discussed how the topics in these four groups could contribute to teaching, based on how they were treated in textbooks.

Keywords: ROSES, interest, textbook analysis

ABS-ICMSCE-24091
**Assessing the Effectiveness of Modified Instruments
on Integrating Reflective Thinking Skills with Science
Concepts**

Pipih Nurhayati, Ari Widodo, Widi Purwianingsih,
Achmad Samsudin

Universitas Pendidikan Indonesia

pipih.nurhayati@upi.edu, widodo@upi.edu,
widipurwianingsih@upi.edu, achmadsamsudin@upi.edu

Reflective thinking skills have been shown to enhance students' learning outcomes in science concepts. However, most developed instruments still focus partially on the integration of reflective thinking skills with the science concepts themselves. This study aims to develop and assess a measurement instrument that integrates reflective thinking skills with science concepts. The chosen concept is energy and living organisms, specifically photosynthesis. The study uses the 4D method, beginning with defining reflective thinking skills, designing the instrument according to predetermined indicators, developing the instrument into a scale with correct and logical statement sentences, and finally disseminating by testing the instrument on participants. The first steps include designing and developing the instrument using four indicators of reflective thinking skills, including habitual action during learning, understanding of science concepts, reflection during learning, and critical reflection on the process and achievements during learning. The research participants are 90 junior high school students in Bandung, West Java from three different schools. The results show that

students have good skills in habitual action (3.29) and critical reflection (3.33), but still need to practice understanding (2.89) and reflection (2.82). The concept of photosynthesis gives more points to critical reflection skills, especially when the statements are related to climate change, they have a paradigm shift that photosynthesis is an important part of the climate change solution.

Keywords: Instruments, Reflective Thinking Skills, Meta-affective, Science Concept

ABS-ICMSCE-24094

Meta-Analysis: General Problem-Solving Model and Student Skills in Science and Mathematics Education

Made Dedi Agustinus, Ravik Karsidi, Sunardi, Murni
Ramli

Universitas Sebelas Maret

m.dediagustinus@student.uns.ac.id,

ravik@staff.uns.ac.id, sunardi.ipuns@staff.uns.ac.id,

mramlim@staff.uns.ac.id

General problem-solving models, including Polya's model, Bransford and Stein's model, and the PISA model, are commonly adopted in science and mathematics education as methods for solving problems, despite limitations in addressing more complex and specific problems. This research aims to analyze the effectiveness of implementing general problem-solving models in improving students' problem-solving skills through a

meta-analysis of 22 primary studies and 24 related datasets. The meta-analysis results show that the application of general problem-solving models has a significant positive effect on students' problem-solving skills compared to conventional learning models ($g = 1.287$, $p < 0.001$). The analysis of moderator variables reveals that the effectiveness of implementing these frameworks is not significantly influenced by the learning domain, educational level, or study duration. However, the application of general problem-solving models in improving students' problem-solving skills is significantly affected by the answer format used in the assessment ($Q = 6.983$, $p = 0.008$), with a greater effect on open-ended response formats compared to multiple-choice formats. Furthermore, the sample size also moderates the effectiveness of implementing these general problem-solving models ($Q = 5.730$, $p = 0.017$), with a more substantial effect on smaller samples (≤ 30 participants) compared to larger samples (> 30 participants). The findings of this research provide valuable insights for educators and policymakers striving to enhance students' problem-solving skills in science and mathematics education.

Keywords: Problem-solving skills, General problem-solving models, Meta-analysis

ABS-ICMSCE-24096

Profile and Urgency of Training Needs for Science Teachers in Designing Student Worksheet

Wiwit Yuli Lestari, Hertien Koosbandiah Surtikanti,
Taufik Rahman, Riandi

Universitas Pendidikan Indonesia

wiwityulilestari1995@upi.edu,

hertien_surtikanti@yahoo.com, taufikrahman@upi.edu,
rian@upi.edu

This research aims to analyze the profile and training needs of science teachers in preparing science practicum worksheets by utilizing local potential. This research is a qualitative descriptive study using questionnaire filling techniques. After the data was collected, it was carried out using descriptive analysis techniques. The population of this study was 30 science teachers. Questionnaires were used to collect data for research. The data that has been obtained is then analyzed. The results of this research show that of the 30 teachers, all of the teachers were not science teachers but only from one specialty, most of the teachers had >10 years of teaching experience, 100% of the teachers felt interested in training in preparing practical learning tools by utilizing local potential, because they had never attended the training. The teacher's desired training time is 2-3 per semester. The largest training activity that was participated in was about laboratory equipment, 30%, but there were 6.6% of teachers who had never attended training. The training method system they wanted to follow was face-to-face 47%, blended 43%, online 10%. The sequence of obstacles to compiling worksheets are available tools and

materials, searching and sorting materials, understanding LKPD, time, how to determine activities, making evaluation and assessment tools, feeling lazy and lack of will, no obstacles, lack of ideas and how to arrange tables. The order of the three main factors for science teachers participating in training activities is content, cost, and distance from the location of the implementation. Only 7.1% of worksheets were created by teachers themselves, and only 50% were validated. The implications of this research are that it is hoped that science teacher training activities will be carried out regularly by paying attention to factors to achieve the expected training objectives, thereby producing a large positive impact.

Keywords: Science Teachers, Student Worksheets, Training Needs

ABS-ICMSCE-24100

**A Survey of Innovator Skills of Thai Grade 12
Students By Supranee Charoenwai, Kulthida
Nugultham and Nantarat Kruea-In**

Supranee Charoenwai, Kulthida Nugultham, Nantarat
Kruea-In

Kasetsart University

supranee.char@ku.th, Kulthida.n@ku.th,

nantarat.p@ku.th

Innovation is about knowledge, concepts, products, services, new processes. Innovators create innovation by generating a new or combining existing things together.

Innovators possess five generic skills linked to innovation creation process: 1) Creative thinking, 2) Questioning, 3) Observing, 4) Experimenting, and 5) Networking. “Questionnaire of Innovator Skills” was developed from a literature review and validated by 3 experts. It consists of 30 questions in a 5-level Likert scale format. From a try out by of 30 Grade 12 students, a non-sample group, reliability was equal to 0.97. The questionnaire was distributed via Google Form to voluntary 118 Grade 12 students, studying in various study programs, from a special-large sized school in Nakhon Pathom, Thailand. The respondents were asked to indicate opportunities to promote their innovator skills. They responded that they had experienced, the 3 highest responses, independent study subjects (55.47%), science projects (53.88%), and science camps (47.52%). It was found that the average score of overall innovator skills was at a high level (Mean=3.95, SD=0.70). The average score of every skill of innovator skills was at a high level as well. Skill of observing gained the highest score (Mean=4.03, SD=0.73). Networking was the skill gaining the lowest score (Mean=3.91, SD=0.75). A Chi square test showed that study program affected innovator skills (Chi square= 202.67, df=162). The results revealed that the students who responded to the questionnaire should receive additional development in creating an innovative community that leads to network building and promotes creative thinking.

Keywords: innovator skills, questionnaire, secondary school

ABS-ICMSCE-24102

**Development of the Rubric for Evaluating Disaster
Prevention Learning in Science Classes: Case
studies in Indonesia and Japan**

Takehiro Hayashi, TUSWADI, FUJIKAWA Yoshinori,
NAKANISHI Yuya, ISOZAKI Tetsuo

Hiroshima University

neko.hiroshima@me.com, tus5800@yahoo.com,
yoshi.fjkw@gmail.com, ynanakanishi@ed.niigata-u.ac.jp,
isozaki@hiroshima-u.ac.jp

We have newly developed the rubric for evaluating disaster prevention learning, especially in science classes at elementary and junior high schools. Disaster prevention learning is conducted in many subjects, such as science, social science, moral study, special activity, etc. Disaster prevention learning in science class is important to focus on features and occurring mechanisms of natural disasters. Based on this idea, we have created disaster learning at both elementary and junior high schools in Banjarnegara (Indonesia) and Hiroshima (Japan), respectively. Then, we have evaluated students' learning using the rubric in both countries. This rubric which horizontal composition includes four understanding levels of the vertical composition. The criteria of four understanding level are “only phenomenon”, “phenomenon and occurring place,” “phenomenon, occurring place, and cause,” and “phenomenon, occurring place, cause, and disasters” in order of deepening and detail. The vertical composition has been selected depending Indonesia(I) and Japan(J), respectively. This vertical

composition includes as follows: “function of water flow” (I, J), “debris flows” (J), “landslide” (I), “tsunami and/or floods” (J), “floods” (I) and “volcanic eruption” (I). For disaster prevention learning in junior high schools, we have evaluated students’ responses using this rubric. In a case of Banjarnegara, students’ understanding of “landslide”, “floods” and “volcano eruption” have been evaluated. In Hiroshima, the students’ understanding of “flood” and “debris flows” have been evaluated. Common in both cases, it was found correlations among understanding scores of above-mentioned compositions have been found (coefficient values in (I) 0.46, 0.53 and 0.55; in (J) 0.63). Consequently, we argue that it seems to indicate that the deepening of knowledge about disasters is increasing regardless of the type of disaster.

Keywords: science class, disaster prevention, evaluation, rubric, elementary school, junior high school

ABS-ICMSCE-24111

Elementary school science teachers’ enactment of epistemic empathy as a responsive teaching strategy for students’ negative epistemic emotions during scientific sense-making

Sally Gutierrez, Moonhyun Han

National Academy of Science and Technology
sbgutierrezpd@snu.ac.kr, xp21478@gmail.com

Our exploratory study attempts to contribute to how epistemic empathy serves as a responsive teaching

strategy for students' negative epistemic emotions while engaged in the scientific sense-making of natural phenomena. We aim to strike a balance between allowing students to experience negative epistemic emotions and providing emotional support through epistemic empathy before those negative emotions intensify and lead to disengagement. Using various data forms including classroom audio and video recordings, field notes, Facial Expression Summary Sheets (FESS), and teachers' reflections, we investigated how two elementary school science teachers' epistemic empathy facilitated students' participation in group activities despite their experience of negative emotions. The classroom recordings were transcribed noting students' tones of voice, facial expressions, and other body gestures and were analysed using latent inductive content analysis through the constant comparison method. Based on our analysis, students experienced the three negative epistemic emotions of anxiety, confusion, and irritation when they were engaged in scientific sensemaking. To avoid disengagement, the teachers employed four epistemic empathy moves in two distinct stages. The first stage, noticing, is a crucial move as it sets the pace for the second stage, comprised of three sub-moves: exploring the cause, providing unconditional acceptance, and providing encouraging words to the students. Our study highlights the significance of addressing not only students' cognitive processes but also their emotions. This implies a need for educators to cultivate an understanding of the emotional dimensions of learning and equip themselves with the skills to empathically respond to students' emotional states.

Keywords: epistemic empathy, epistemic emotions, negative epistemic emotions, responsive teaching; scientific

ABS-ICMSCE-24119

Exploring the Efficacy of Inquiry-Based Learning Models: A Narrative Review

Kasmanto, Paed.Sjaeful Anwar

UPI

pkasmanto1@upi.edu,

The purpose of this journal article review is to analyze the use of inquiry learning models as either an approach or learning model in order to improve students' abilities. The method used is a narrative review. A total of 16 journal articles were reviewed to determine the use of inquiry learning models. The review found that the most commonly used inquiry learning model was The Guided Inquiry Learning for elementary and middle school students, while Argument Driven Inquiry (ADI) was frequently used for high school students. Open Inquiry Learning was used for higher level students (high school). Research on inquiry learning has generally found that it can lead to improved student outcomes, including increased critical thinking and problem-solving skills, deeper understanding of subject matter, and increased motivation and engagement in learning. However, the specific skills that are improved may depend on the specific inquiry learning activities and tasks used, as well as the age and prior knowledge of the students. Based on

the analysis, it can be concluded that inquiry learning models can have a positive impact on learning

Keywords: Inquiry Learning Model, ADI, Students' Ability

ABS-ICMSCE-24125

An Investigation into Fluid Mechanics Course Profile to Improve Science Pre-Service Teacher's Logical Thinking Skill

Diniya Diniya, Dadi Rusdiana, Asep Kadarohman, Ida Kaniawati, Nuryani Rustaman, Muslim

Universitas Pendidikan Indonesia

diniya@upi.edu, , kadar@upi.edu, kaniawati@upi.edu, nuryanirustaman@upi.edu, muslim@upi.edu

The aim of the current research is to get an in-depth picture of the lecture profile and difficulties of prospective science teacher students in fluid mechanics. The subjects were selected from both the students and lecturer in fluid mechanics course in one of the science education departments at a state university in the city of Pekanbaru. Conducted through the Miles and Huberman method, the data were collected through observation, interviews and documentation. Logical thinking skill test (LTST) processed using descriptive statistics with the help of SPSS 26.0. Based on the results, the mean score of LTST is 47,36. It can conclude that students' logical thinking is still low. Supported by observations and interviews, it disclosed that lectures still use the lecture method assisted

by PhET simulation media while students only listen. The examples and practice questions are still at cognitive level C3 according to Bloom's Taxonomy. Thus, the current fluid mechanics has not been able to train students' critical thinking skills. Innovation is crucial needed in fluid mechanics learning to improve students' critical thinking skills.

Keywords: Fluid Mechanics Course, Logical Thinking Skill, Science Pre-service Teacher

ABS-ICMSCE-24153

**DESIGN THINKING IN SCIENCE EDUCATION:
A CHALLENGE AND AN OPPORTUNITY**

Deni Moh Budiman, Dadi Rusdiana, Achmad Samsudin,
Riandi

Universitas Pendidikan Indonesia
denimohbudiman@upi.edu

The use of design thinking is seen as a crucial method to develop 21st century skills, and there is a corresponding increase in demand and interest in introducing design thinking to all students. This study aimed to examine high-quality empirical research on design thinking in learning and to explore future research possibilities. Using a systematic search of online databases through keyword searches and snowballing, this review included 45 studies from 23 SSCI journal papers. The findings indicate that: (1) The integration of design thinking into all education has become increasingly popular over the past five years,

with most empirical studies targeting college students in small groups over a short period; (2) Studies tend to focus on STEM-related curriculum areas by incorporating non-standardized design thinking models or processes, and core design thinking concepts in all education, including empathize, define, ideate, prototype, test, evaluate, and optimize, are frequently valued and pursued; (3) Design thinking is the most frequently evaluated learning performance, followed by emotional/social aspects, subject learning performance, and skills. Qualitative assessments are more commonly used for evaluation, with instruments such as surveys/questionnaires, portfolios, interviews, observations, and protocol analysis; (4) Non-experimental learning, formal instruction, collaborative learning, and interventions using traditional tools and materials were mainly applied to unrestrained and challenging activities in real-world design thinking in learning. Overall, the 45 papers suggest that design thinking has significant pedagogical potential in classrooms, but empirical evidence supporting the effectiveness of design thinking in learning is limited. This review also discusses research gaps and future directions based on peer-reviewed research.

Keywords: Design thinking Pedagogy Systematic review

ABS-ICMSCE-24161
**Investigating Technology and Engineering Literacy
of Students in Integrated Science Education: A Case
Study**

Defrizal Hamka
Universitas Pendidikan Indonesia
defrizalhamka@upi.edu

This research aims to investigate the profile of technological and engineering literacy possessed by students and how technological and engineering literacy is possessed by students in Integrated Science courses. The method used is case studies, semi-structural interviews are used to collect data from respondents. The respondents selected were 3 students from the Science Education study program, provided that the students had passed courses in the fields of physics, biology and mathematics. Data from various sources reveals that students' technological and engineering literacy has various aspects, involving aspects of technology, society, design, systems and information and communication technology. Each of these various aspects varies between students, both in terms of practice in understanding technological principles, finding and solving problems, collaborating and communicating with the community. Findings reveal varying levels of technological and engineering literacy among students, highlighting strengths and weaknesses in the understanding and application of these concepts. Overall, this case study contributes to the broader discussion regarding the importance of technological and engineering literacy in science education and offers insight for educators who

wish to further integrate these concepts into their curriculum.

Keywords: technology and engineering literacy, integrated science education, case study

ABS-ICMSCE-24162

**Perspectives for Studying Inquiry-Based Learning
through Lesson Study in Malaysia**

Toshinobu Hatanaka, Nur Jahan Ahmad

Toho University

hatanaka@c.sci.toho-u.ac.jp, jahan@usm.my

Lesson study is widely known around the world as a practice that supports the professional development of Japanese teachers. Japan has also been cooperating in improving education in other countries through lesson study as part of international educational cooperation. This study aimed to specifically clarify the perspectives for improving lessons during the Professional Learning Community Program (PLC) to support lesson study in Malaysia by utilizing the accumulated educational practices of Japan. In this study, following the practice in Japan, two case studies were conducted in which the lesson study's procedure was implemented in two science classes with external advisors, where teachers within the school collaborated to plan, conduct, and reflect on the lessons. The participating schools were a primary and a junior secondary schools. The advice given during the lesson planning, the actual lessons conducted, and the

teachers' comments during post-lesson reflections were analyzed to qualitatively identify their characteristics. The findings indicated that it is possible to use Japanese lever teaching materials and videos aligned with the lessons. On the other hand, it was observed that teachers were struggled with several aspects of constructing the lessons that consider the inquiry process: clarifying the problems students face, guiding students to properly conduct experiments and collect data, and identifying the answers to the problems based on experimental results. It is inferred that Malaysian teachers are unfamiliar with integrating inquiry-based lessons; therefore, it is suggested that examining inquiry-based lessons through lesson study with external advisors is useful.

Keywords: Lesson Study, Inquiry-based science lesson, International Collaboration

ABS-ICMSCE-24163

A Systematic Literature Review: The Use of Digital Media Assessment in science learning

Olyivia Retdwina Rusma
Universitas Pendidikan Indonesia
olyiviaretdwinarusma@upi.edu

The study aims to identify and analyze the digital assessment media used in IPA learning. The method used is PRISMA-P (Preferred Reporting Items for Systematic Reviews Meta-Analyses Protocol) with the PICOC approach. The collection of articles is taken from the

Publish or Perish (PoP) database, which contains various types of journals indexed with scopus. Based on the application, 1888 articles related to Digital Media Assessment were obtained. After filtering the title results, 235 articles were obtained, and based on abstracts and keywords, 13 articles qualified to be analyzed. Analysis shows that the most common types of digital media are: kahoot, wardwall, mentimeter and quizziz. For the direction of advanced research directed the use of digital assessments that can support assessments in science learning

Keywords: Digital Media Assessment, Science Learning, Systematic Literature Review

ABS-ICMSCE-24164

**Analysis of Ethnoscience Research Opportunities in
Science Education: Systematic Literature Review**

Atiqah Ulya Hayandi

Universitas Pendidikan Indonesia

atiqahulyahayandi@upi.edu

The aim of this research is to analyze research findings and trends related to ethnoscience in science learning. This research is a systematic literature review using the prism method. This research data is a research article about ethnoscience without time limits. Articles are collected from the Scopus database with the Publish or Perish (PoP) search application. Based on the search results, it was obtained that ethnoscience research first

appeared in 1967 and results obtained were 100 research articles related to ethnosience until 2024. The filter results and based on keywords from these articles obtained 23 articles that met the requirements for analysis. The results of the analysis show that ethnosience-based science learning has an important role in encouraging students to solve problem topics in learning. The application of ethnosience-based learning to Natural Science (Science) material can be integrated by adapting learning models, teaching materials and learning media that are centered on student background and research results state that ethnosience-based science learning is proven to be able to develop students' abilities in the 21st century. Results The analysis shows that there are still very few study and research topics related to ethnosience. Therefore, further research is needed that can be linked to the use of ethnosience-based interactive learning media that can improve students' abilities in the 21st century.

Keywords: Ethnosience, science learning, interactive learning media, systematic literature review

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**Epistemic Uncertainty in Science Education: A
Position Paper**

Ka Lok Cheng

Faculty of Education, The University of Hong Kong
chengkla@hku.hk

The uncertainty of scientific knowledge is an essential aspect of the Nature of Science and is essential for students' holistic understanding of science as a discipline. Among the various uncertainties, epistemic uncertainty is directly associated with scientific understanding and is vital in science-related personal and societal decision-making. However, compared to scientific communication literature, most scholarly works of science education focused on the epistemic uncertainties encountered by the students instead of those inherent to scientific knowledge. This position paper advocates for greater inclusion of the discussion of epistemic uncertainty in the curriculum materials. The paper considers three cases across three common science subjects in secondary education: evolutionary changes, quantum mechanics, and acid-base theories. By analysing these three cases, one can identify the lack of emphasis on uncertainties due to the limited experimental data, the complexity of natural phenomena, and the incomplete theoretical framework model. It is further advocated in this paper that explicit dialogues on epistemic uncertainty should take place in science classrooms. It is expected that the current paper could draw attention to the communication of uncertainty in school science and further fuel the academic dialogue on the instruction of the Nature of Science.

Keywords: Epistemic Uncertainty, Nature of Science, Science Education, Secondary Education

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Science Classes in Indonesia and in Japan: A Case of Junior High School in Banjarnegara and in Hiroshima

FARKHAH NOFIANTI, TUSWADI, RETNO
PUSPITORINI

SMP NEGERI 1 BANJARNEGARA JAWA TENGAH
farkhahnofianti51@guru.smp.belajar.id,
tus5800@yahoo.com, retnpushpito@gmail.com

Natural Science is one of the compulsory subjects at Indonesian and Japanese junior high schools. This study tries to observe the similarities and differences between Science Classes in a school in Banjarnegara and a school in Hiroshima for grade VIII students. Through class room observations in both classes and data analysis, it was found out the similarities are: 1. The size of the laboratory is the same with table and chair; 2. The opening is the same in which the teachers explain the goals of learning; and 3. Both classes use experiment in groups. The differences are: 1. The equipment of the Japanese school laboratory is more complete: it has 16 lamps and 6 fans while Indonesian school laboratory only has 1 fan and 1 lamp; the Japanese class uses a blackboard with colorful chocks and the Indonesian class uses a white board with black board marker; 2. The Japanese teacher uses authentic text material, but the Indonesian teacher does

not, 3. The Japanese teacher explain the expected result of the experiment; but the Indonesian teacher does not, 4. The Japanese teacher draw experiment illustration and wrote down the goal of the experiment on the blackboard; but the Indonesian teacher does not, 5. The Japanese teacher gave example of how to arrange the experiment equipment and materials on his table; but the Indonesian teacher does not; 6. The students in Indonesian class did presentation to report the experiment result, but the Japanese class does not, and 7. The Japanese students have already known the expected result of the experiment, but the Indonesian students have to prove it through experiment. These findings show that the teaching flow of Science lesson in two countries can be different but they have the same goal to make the students understand the material content in food.

Keywords: Keywords: Science lesson, experiment, teacher, students, junior high school

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What and how technology and industrial content should be taught in science: from a historical perspective on the formation of science in the Meiji period.

Yuya Nakanishi
Niigata University
ynakanishi@ed.niigata-u.ac.jp

In Japan during the Meiji period, a modern educational system was rapidly established due to the influence of technological innovation from Western countries and wars. Curriculum and content were developed in elementary and secondary education in order for students to learn content related to technology and industry. This study clarifies the origins of science education in Japan and the relationship between science, technology and industry in science education by exploring the following research questions: (1) What were the objectives and aims of teaching technology and industry in science, and (2) How was the new science education integrated with existing science education? In Japan during the Meiji period, technology and industry were also studied in school science education in order to promote the country's development through industrialization. Furthermore, the introduction of practical science necessitated enhancements to procedures and methods, requiring an understanding of theories and laws. In addition, educators believed that cultivating proper character involved emphasizing the rationale behind phenomena, drawing from metaphysical concepts.

This reveals that in Japan, the importance of each of "Rigaku" (principle science) and "Jutsu-gaku" (applied science) was claimed and opinions were in conflict, but as a result, both were considered important, and the philosophy and content of science were formed in a way that both opinions were compatible. The study highlights the need to discuss what and how scientific knowledge should be taught in science education, with what objectives and aims, when dealing with technological and industrial content. The results of this study will help us to consider why and how content about technology and industry should be incorporated in STEAM education and cross-curriculars in the future.

Keywords: Japan, Meiji period, STEM, historical perspective

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**Public Understanding and Attitudes towards AI:
Implications for Science Education**

Chun Ju Huang

National Chung Cheng University

cjhuang@ccu.edu.tw

In the context of rapid technological advancements, many technological issues have become increasingly complex and multifaceted. This is particularly true for digital technologies such as AI, big data, algorithms, and robotics, which have permeated and profoundly impacted

modern society. Beyond the continuous technological progress, these technologies challenge the norms of current societal operations and engage in intricate and complex relationships with various social, cultural, economic, and ethical factors. The development of these issues urgently requires broader public participation to construct more comprehensive societal lifestyles and appropriate technological visions. Against this backdrop, this study aims to analyze the public's understanding and perceptions of AI technologies, as well as their attitudes towards related issues such as functionality, ethics, and governance. Utilizing an online questionnaire, the study commissioned a professional survey distribution company to conduct the survey in late July 2023, and a total of 610 valid questionnaires were collected. The survey results revealed that respondents of Taiwan had a good understanding of the principles of AI operation, tended to trust AI technology on many issues, and affirmed that AI would bring benefits to human life. In terms of governance, the public had the most confidence in the involvement and supervision of scientific institutions. The overall results present a certain degree of dissonance, indicating that the public's understanding of AI principles does not necessarily translate into a reserved attitude towards AI's effects. These findings have significant implications for promoting AI literacy and public science education.

Keywords: AI, Appropriate Technology, Science Education

ABS-ICMSCE-24185
**Profiles of Science Teachers Competency In
Managing Laboratory Activities At Secondary
School: A Survey Study**

Jaka Afriana, Anna Permanasari
Universitas Pakuan

jakaunpak@gmail.com, anna.permanasari@unpak.ac.id

In this study, the competency profile of science teachers mainly in managing laboratory was explored Based on Indonesian National Competency Work Standards (SKKNI). The qualitative research was done involving 143 science teachers who filled out questionnaires related to self-confidence in the competence of managing the laboratory. Interviews with several teachers and analysis of documents for laboratory managers in several countries were also conducted to deepen analysis related to teacher competency needs. The result shows some weaknesses of science teachers in managing laboratory, such as laboratory quality document management, laboratory waste management, classification and handling chemicals as well as basic science laboratory skills. Moreover, in Indonesia context, the Ministry of Education itself has not developed a standardized framework on the competence of science education laboratory managers. Meanwhile, the Indonesian Industrial Ministry has developed a framework of basic laboratory competencies for industrial and testing laboratories. The study provides the effort to develop competency standards for school science laboratory managers and its CPD.

Keywords: Science Teachers; Laboratory Management, Competencies standard for science education laboratories

ABS-ICMSCE-24194

Analyzing the Impact of Augmented Reality on Student Learning Outcome in K-12 Science Education: A Meta-Analysis Study

Dian Purnama Ilahi, Prof. Dr. Festiyed, M.S, Dr.

Yulkifli., S.Pd., M.Si

Universitas Negeri Padang

dian.purnama.ilahi02@gmail.com,

festiyed@fmipa.unp.ac.id, yulkifliamir@gmail.com

Augmented reality (AR) technology integrates digital information with the physical world, providing an interactive and immersive experience for users. In education, AR has the potential to increase student engagement and understanding by bringing abstract concepts to life. Although there have been many review studies on augmented reality in education, a review of augmented reality in K-12 science education (K-12 education in American terminology generally refers to elementary and secondary school levels) has never been conducted. This study aims to see the effect of using augmented reality on student learning outcomes in K-12 science education. This type of research is a Meta-Analysis. Data from this study was accessed from Scopus, ERIC and Google Scholar databases. This study uses the results of research that has been conducted between 2013-

2024 which using the inclusion criteria obtained 22 studies. Of the 22 studies, there were 4 studies that each compared one experimental class with two control classes, making a total of 26 studies analysed. Data analysis was used with JASP software. The results showed that augmented reality provides moderate effectiveness on student learning outcomes in K-12 science education ($r_{RE} = 0.640$; $SE = 0.153$; $z = 4.186$; $p < 0.001$). These results can explain that augmented reality can improve student learning outcomes in K-12 science education.

Keywords: Augmented Reality, Student Learning Outcome in K-12 Science Education, A Meta-Analysis Study

ABS-ICMSCE-24202

Does Home-Based Experiment (HBE) Enhance Scientific Skills among Middle School Students?

Sirry Alvina, Mellyzar, Syarifah Rita Zahara

Universitas Malikussaleh

sirry.alvina@unimal.ac.id, mellyzar@unimal.ac.id,

syarifah.rita@unimal.ac.id

This research aims to explore the interrelationships among Science Process Skills (SPS) indicators through Home-Based Experiments (HBE) in science education. Employing a qualitative correlational study approach, the sample consisted of 77 seventh-grade students from Lhokseumawe, Aceh Province, Indonesia. Data were

collected using test questions and observation sheets, analyzed with SPSS-25 through non-parametric Kendall's correlation tests. To examine the relationship between HBE-based SPS and scientific concepts via science literacy questions, Spearman's rank correlation tests were conducted at a 0.05 significance level. Findings revealed a moderate correlation between the skills of observing and making hypotheses. The correlation between conducting experiments and communication was weak, while interpreting data and concluding showed a moderate correlation. However, Spearman's rank correlation indicated no significant correlation between science literacy and SPS, with a significance value of $0.281 > 0.05$. Although HBE practical provide opportunities for direct application of SPS, science literacy and SPS focus differently. Science literacy emphasizes understanding scientific concepts through text, whereas SPS relates to applying these concepts in observation, experimentation, and data analysis.

Keywords: science process skills, science education, qualitative correlation study, science literacy

ABS-ICMSCE-24227

**Analysis of Students' Scientific Literacy Based on
Gender and Students' Interests**

Ana Yuniasti Retno Wulandari, Dwi Bagus Rendy Astid
Putera, Maria Chandra Sutarja
University of Trunojoyo Madura
ana.wulandari@trunojoyo.ac.id,
dwi.bagus@trunojoyo.ac.id,
maria.sutarja@trunojoyo.ac.id

Scientific literacy is one of students' important abilities. Having this ability makes it easier to solve their everyday life problem using their science concept. This study aims to analyze students' scientific literacy based on gender and students' interests. The instruments used were scientific literacy tests and student interest questionnaires. The research sample was 125 students consisting of 72 female students and 53 male students. Data analysis techniques used Mann Whitney U test and One-way ANOVA followed by the Scheffe test. The results of this study concluded that: (1) there is no difference in scientific literacy between male and female students with a significance value of Mann Whitney U test results of 0.851, (2) there are differences in scientific literacy in terms of student interest with a significance value of one-way ANOVA test results of 0.005. Students with high interest have better scientific literacy than students with moderate and low interest. The results of this study should be a consideration for teachers in implementing learning to improve students' scientific literacy by focusing on students' interests and understanding.

Keywords: Gender, Scientific Literacy, Students' Interest

ABS-ICMSCE-24233

Analysis of Science Teachers' TPACK Skills and Understanding of Science Literacy in the Northern Region of Lumajang City

fairuz maharani, Indrawati, Erlia Narulita, Iwan

Wicaksono

Universitas Jember

fairuzmaharani35@gmail.com,

indrawatisutarto@gmail.com, erlia.fkip@unej.ac.id,

iwanwicaksono.fkip@unej.ac.id

The rapid development of technology in various educational sectors encourages the world of education to change and adapt to face the era of the Industrial Revolution 4.0. The industrial revolution 4.0 is marked by the digitalization era, one of which is technology as a tool that facilitates the learning process. TPACK is knowledge that utilizes technology in teaching a scientific context. This study aims to determine the TPACK ability of teachers as well as the needs of teaching materials for teachers and students. The research type used is quantitative method through survey method. The survey method was chosen in this study because it makes it easier for researchers to analyze the results of research data. The sample of this research was 10 science teachers and 150 students grade seven junior high school in northern region of Lumajang city. The results of the study said that the ability of Technological, Pedagogical, and Content

Knowledge (TPACK) of science teachers at junior high school in northern region of Lumajang city all categories of TPACK ability can be said to be good. However, there is still a need to increase science teachers TPACK understanding of scientific literacy to create a better learning environment.

Keywords: Science Literacy, Science Learning, TPACK

ABS-ICMSCE-24252

Systems thinking in science and environmental education: A systematic review of the literature

Leo Muhammad Taufik, Ari Widodo, Taufik Rahman,
Hertien Koosbandiah S.

UPI

leo.mt@upi.edu, widodo@upi.edu

Systems thinking (ST) is an interdisciplinary field that provides various approaches to comprehending the behavior and structure of complex systems. The objective of this study is to provide an overview of the research trends in the field of systems thinking. The research method used is a Systematic Literature Review (SLR) method. The research data consists of research articles on system thinking in science and environmental education over the last five years. The articles were sourced from the extensive Scopus database, which includes reputable sources such as IEEE, Springer, and the powerful Publish or Perish (PoP) search application. A total of 207 articles from the years 2019-2024 were found using the search

engine. Filtering the titles and identifying the keywords from these articles led to 42 eligible articles for analysis. The analysis indicates that the number of studies and citations has increased each year. Utilizing various search tools, this research identifies influential authors, top journals, and contributing organizations and countries in the field of systems thinking. The study analyzed citations and novelty in research to rank the most influential articles in the field of systems thinking. Additionally, network analysis was used to identify major clusters in the existing literature based on the research area of systems thinking. The findings from this study will provide a guide for practitioners and academics to conduct future research in the context of systems thinking.

Keywords: System Thinking, Sains, Environmental, Systematic Literature Review

ABS-ICMSCE-24257

**Development of Interactive Articulate Storyline-
Based Science Learning Videos to Improve Critical
Thinking Skills of Junior High School**

Nur Ahmad, Devi Novita Lutfitria Anggraini, Ulin
Nuha, Pramudya Dwi Aristya Putra

Universitas Jember
masnurauai.fkip@unej.ac.id

The purpose of developing Interactive Articulate Storyline-Based Science Learning videos is to evaluate their applicability while producing learning videos that are valid and effective. The study uses the five-stage ADDIE model analysis, design, development, implementation, and evaluation to accomplish this aim. A panel of validators evaluates the IPA learning video once it was created to ascertain its authenticity. With a validation score of 87.94% from three validators, the validation process' outcomes demonstrate a high degree of validity. Furthermore, the Interactive Articulate Storyline-Based Science Learning Videos' practicality assessment shows a score of 92.47%, highlighting its applicability. Regarding efficacy, the instructional video exhibits noteworthy progress, as demonstrated by an impressive N-gain score of 0.74 between the pretest and posttest, when students' performance increasing to 82.86%. Overall, the produced videos improves both the understanding and delivery of instructional information and is a useful learning tool for high school students.

Keywords: Articulate Storyline; Learning Videos; Critical Thinking Skills;


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Managerialism, Educational Equity, and Professional Development of Teachers: A Case of Groupplized Schools

Wentao Yao, Yangying Wang, and Guopeng Fu College of Teacher Education, East China Normal Univeristy
gpfu@cte.ecnu.edu.cn

The global pandemic has accelerated the global fragmentation of students, faculty, and educational institutions (Mutton, 2020). To promote education equality and the share of high-quality educational resources, school groupplization under the influence of managerialism has become a research focus in China (Fu, 2023). School groupplization in this study refers to a school community consisting of one famous school and several other schools. At a macro level, school groupplization under managerialism influences has promoted educational equity, optimized the distribution of educational resources, and innovated and developed the school management system to some extent. For example, some scholars believe that school groupplization is an effective way to promote educational equity because it expands the fair opportunity for disadvantaged groups in society to enjoy high-quality education (Yang, 2014; Yu, 2006). School groupplization effectively expands high-quality resources in China's compulsory education system, and to a certain extent mitigates the long-standing uneven distribution of compulsory education resources in China. Zhou (2005) pointed out that the sharing of educational resources can be achieved through the redistribution of both educational funds and human

resources such as personnel transfer, teacher exchange programs. In addition, school groupization makes more schools integrate ideas in market economy development into school administration philosophy, applying modern enterprise management system to school management, and making the management of each school more standardized, institutionalized, professional, and modern. At a micro level, school groupization is conducive to the implementation of teacher professional development activities and has the potential to improve the overall teaching quality of the entire school group. Scholars summarized the positive effects of school groupization on teachers as follows: school groupization brings teachers from individual schools to a larger platform created by the group. Frequent inter-school communication and exchange activities enrich teachers' experience (Guo & Cheng, 2020). Professional development activities organized by school groups could increase teaching, research, and project collaboration among schools, create opportunities for teachers to flow between schools and learn from different teachers, and improve the teaching quality of the entire group. Existing research mainly expects or rationalizes the potential benefits of school groupization for teacher professional development. Little is known about the practice in these school groups. This study, thus, examines the professional development activities at a school group in Shanghai, China. It focuses on teachers' perspectives on professional development under school groupization as an embodiment of managerialism.



Keywords: Managerialism, Educational Equity, and Professional Development;

