Book of Abstracts

International Conference on Science Education

ICoSE 2025

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PREFACE

Foreword by Rector Universitas Negeri Malang (UM)

Assalamu'alaikum Warahmatullahi Wabarakatuh

It is with great pride and enthusiasm that I extend my warmest welcome to all participants of the International Conference on Science Education (ICoSE) 2025, hosted by the Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang.

As one of Indonesia's leading institutions in teacher education and scientific advancement, Universitas Negeri Malang (UM) is committed to fostering academic excellence, innovation, and global collaboration. ICoSE 2025 stands as a testament to these values—bringing together educators, researchers, and practitioners from around the world to exchange ideas, research findings, and pedagogical strategies in the realm of science education.

This year's conference provides a vital platform to reflect on emerging trends and challenges in science teaching and learning, especially in the context of sustainability, digital transformation, and inclusivity in education. We believe that science education plays a crucial role in shaping informed citizens and empowering future generations to address complex global issues. The theme of this year's conference, "Promoting Sustainable Energy and Environment," reflects our shared responsibility to address global environmental challenges through education, research, and innovation.

I would like to take this opportunity to express my sincere appreciation to the keynote speakers for their valuable contributions and presence:

- Assoc. Prof. Andrew Adewale Alola, Universitetet i Innlandet, Norway

- Prof. Maija Aksela, Helsinki University, Finland

- Asst. Prof. Jina Chang, Nanyang Technological University, Singapore

- Dr.rer.nat. Safwatun Nida, Universitas Negeri Malang, Indonesia

Their insights and experiences enrich our academic discourse and provide global perspectives that are essential to advancing science education in a rapidly changing world.

My heartfelt gratitude also goes to the organising committee, contributors, and all attendees who have made this conference possible. Your dedication, collaboration, and scholarly spirit are the foundation of ICoSE's success.

May this conference serve as a meaningful step toward strengthening international networks, inspiring innovative educational practices, and reaffirming our shared commitment to the advancement of science education for a better future.

Thank you, and I wish you a fruitful and inspiring conference.

Wassalamu'alaikum Warahmatullahi Wabarakatuh

Prof. Dr. Hariono, M.Pd.

Rector, Universitas Negeri Malang

PREFACE

Foreword by The Dean of Faculty of Mathematics and Natural Sciences,

Universitas Negeri Malang (UM)

Assalamu'alaikum Warahmatullahi Wabarakatuh

On behalf of the Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, I warmly welcome all participants to the **International Conference on Science Education (ICoSE) 2025**, hosted here in Malang, East Java, Indonesia. Our faculty, known as a centre of excellence in science education, research, and innovation, has a long-standing commitment to nurturing critical thinkers and future educators. Led by esteemed scholars and educators, we remain dedicated to advancing the quality of science teacher preparation and pedagogy.

ICoSE 2025 brings together educators, researchers, policymakers, and practitioners from around the world to share insights and best practices in science teaching and learning. The conference's theme aligns closely with our institution's mission: to promote **innovative, sustainable, and globally-minded approaches** to science education. Through keynote speeches, parallel sessions, and panel discussions, we aim to foster interdisciplinary dialogue and collaborative partnerships that transcend geographic and disciplinary boundaries.

I would like to express our most profound appreciation to our distinguished keynote speakers whose presence and insights greatly enrich this conference:

- **Assoc. Prof. Andrew Adewale Alola**, Universitetet i Innlandet, Norway
- **Prof. Maija Aksela**, Helsinki University, Finland
- **Asst. Prof. Jina Chang**, Nanyang Technological University, Singapore
- **Dr.rer.nat. Safwatun Nida**, Universitas Negeri Malang, Indonesia

Their contributions not only reflect the global dimension of this conference but also provide invaluable perspectives that inspire further innovation in science education research and practice.

As Dean, I also extend sincere gratitude to all presenters, reviewers, organising committee members, and supporting institutions whose dedication and collaboration have made this event possible.

We hope that participation in **ICoSE 2025** will spark novel pedagogical ideas, foster enduring research partnerships, and contribute meaningfully to the global movement for sustainable and high-quality science education.

Thank you for your active engagement and enthusiasm. We look forward to a conference filled with insight, inspiration, and innovation.

Wassalamu'alaikum Warahmatullahi Wabarakatuh

Prof. Dr. Hadi Suwono, M.Si.

Dean, Faculty of Mathematics and Natural Sciences

Universitas Negeri Malang

Greetings from The Committee

Assalamu'alaikum Warahmatullahi Wabarakatuh,

It is a great honour and pleasure for me, on behalf of the organising committee, to welcome all distinguished speakers, presenters, and participants to the International Conference on Science Education (ICoSE) 2025, hosted by the Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang.

This year's conference focuses on the timely and vital theme: "Promoting Sustainable Energy and Environment." The challenges of global environmental change, energy needs, and sustainability demand a transformative approach in science education. Through this conference, we aim to foster a meaningful academic space where scholars, educators, researchers, and practitioners can share innovative ideas, research findings, and best practices that address these issues through science teaching and learning.

We are also proud to announce that ICoSE 2025 is being conducted in conjunction with the AMLI Meeting 2025 — the annual gathering of Asosiasi MIPA LPTK Indonesia, with the Faculty of Mathematics and Natural Sciences at Universitas Negeri Malang serving proudly as the host. This collaboration adds further depth and national importance to the event, promoting greater synergy between science education researchers and institutions across Indonesia.

We are honoured to feature distinguished keynote speakers from different parts of the world, whose expertise and insights greatly enhance the academic depth and global perspective of this event.

- Assoc. Prof. Andrew Adewale Alola, Universitetet i Innlandet, Norway

- Prof. Maija Aksela, Helsinki University, Finland

- Asst. Prof. Jina Chang, Nanyang Technological University, Singapore

- Dr.rer.nat. Safwatun Nida, Universitas Negeri Malang, Indonesia

We are pleased to inform you that over 100 abstracts have been submitted from participants representing a diverse range of institutions and countries. This enthusiastic response reflects a growing commitment among science educators to engage in meaningful dialogue and collaboration. Selected full papers presented at the conference will be undergo peer review and be published in the IOP Journal of Physics: Conference Series, ensuring wider academic dissemination and global accessibility.

To all presenters and participants, we sincerely thank you for your contributions and enthusiasm. We believe that your active involvement will encourage lively discussions and foster new collaborations that will extend beyond the conference itself.

I also wish to thank the entire committee team, reviewers, AMLI members, and supporting institutions for their hard work and commitment in preparing this joint event. May ICoSE 2025 and the AMLI Meeting 2025 serve as valuable forums for advancing science education, building national and international partnerships, and inspiring collective action toward a sustainable and inclusive future.

Wassalamu'alaikum Warahmatullahi Wabarakatuh

Prof. Habiddin, S.Pd., M.Pd., M.Si., Ph.D.

Chief Executive, ICoSE 2025

KEYNOTE SPEAKER

Prof. Maija Aksela.

Helsinki University, Finland

Assoc. Prof. Andrew Adewale

Universitetet I Innlandet, Norway

Dr. rer. Nat. Safwatun Nida

Universitas Negeri Malang

Asst Prof. Jina Chang

Nanyang Technological University, Singapore

INVITED SPEAKER

Dr. Oktavia Sulistina, S.Pd, M.Pd

Universitas Negeri Malang

Eva Ari Wahyuni, PhD

Universitas Trunojoyo Madura

DAFTAR ISI

Keynote Speaker

Energy-transport tax and passenger cars emission

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ABSTRACT

Like other parts of the world, the European Union (EU)'s road transport sector is central to its carbon neutrality goal given that the sector accounts for about 77% of the total EU transport greenhouse gas (GHG) emissions. By looking at two EU scenarios (i.e. for states with the highest and lowest number of passenger cars per thousands of inhabitants), the study looks at whether and to what degree vital environmental-related taxes i.e., energy and transport tax alongside economic and socioeconomic factors influence GHG emissions from passenger cars. While transport tax failed to show a significant impact on GHG emissions from passenger cars among the EU member states with the highest number of passenger cars per thousands of inhabitants, the impact is rather detrimental to environmental sustainability in the EU member states with the lowest number of passenger cars per thousands of inhabitants. This evidence suggests the need to further revise the specifics of transport tax in the EU and especially the low-income member countries. Moreover, as expected for the scenarios, the increase in gross domestic product (GDP) and population spur GHG emissions from passenger cars.

Keywords: *transport sector; passenger cars; greenhouse gas emission; European Union.*

Guiding STEM Problem-Solving Through Epistemic Norms: Supporting Student Learning Dynamics and Risk-Taking

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ABSTRACT

STEM problem-solving involves complex, open-ended, and often uncertain processes that require 21st-century competencies. Supporting students through such dynamic learning remains a key challenge—how can educators navigate this uncertain and complex process while staying true to the core values of STEM education?

This talk explores how epistemic norms—shared expectations for building and applying knowledge—can help educators navigate this complexity. Based on Grade 9 STEM classroom observations in Singapore, it highlights three key norms that support effective problem-solving. First, students are encouraged to define real-world problems that are personally relevant and practically manageable. Second, they are supported in developing creative yet realistic solutions. Third, they are expected to engage in iterative cycles of testing and refinement, making use of available tools and aligning their efforts with their developing skillsets.

These norms embody six foundational values: usefulness, creativity, and iteration as central to STEM practice, and accessibility, concreteness, and feasibility as vital contextual anchors. Importantly, encouraging unconventional thinking (creativity), experimenting through trial and error (iteration), and developing practical yet accessible solutions (usefulness, feasibility, and concreteness) all involve learning from setbacks as an essential part of the process. In this sense, fostering these six values also means supporting students in taking intellectual risks. By cultivating environments where such risk-taking is seen as productive, educators can better manage the evolving dynamics of STEM learning and empower students to engage confidently with uncertainty, all while tailoring support to match diverse levels of competency.

Engaging youth and teachers on sustainable energy education

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ABSTRACT

Sustainable energy is one of main topics in sustainable education. This talk open how to engage youth and students on sustainable education through collaboration with schools, universities and society. Some practical pedagogical solutions will be shared from Finland.

From Field Experience to Classroom Innovation: A Case Study in Promoting Relevant Education in Science for Sustainability through Student Teachers' Development of Sustainability-based Teaching Resources

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ABSTRACT

This case study draws on a course delivered under the ERASMUS+ project Promoting Relevant Education in Science for Sustainability (PRESS), involving 34 student teachers from the Science Education Department, Universitas Negeri Malang, Indonesia, during the September–December 2024 period of the 2024/2025 academic year. The course, Development of Teaching Resources (4.5 ECTS), aimed to equip students with the knowledge and skills to develop sustainabilityoriented teaching materials. Learning activities included lectures, a non-formal field trip, project work, presentations, and peer and expert reviews. For the field trip, participants visited at least one of the following sites: Bajulmati Sea Turtle Conservation, Javan Langur Center (JLC), Wonosari Tea Farm, or the Zoological Museum. Working in eight groups, with two groups assigned to each site, students designed teaching resources based on the contexts they explored. The study addressed two research questions: (1) What pedagogical models did student teachers develop for sustainability teaching in the school science curriculum following their field trips? and (2) What were their perspectives on designing sustainability-based teaching resources? RQ1 was explored through content analysis of the students' learning artefacts, while RQ2 was examined through a post-course survey of all participants. Findings revealed that the student teachers developed diverse pedagogical models for Junior Secondary School science, aiming to raise students' awareness of ecosystem components, their roles in maintaining ecological balance, and strategies for addressing environmental issues caused by human activity. The teaching resources incorporated various educational games—such as card games, snakes and ladders, and puzzles—with most groups integrating QR codes to provide extended information access, and one group using augmented reality (AR) media. Survey results indicated that most participants responded positively to the course, as reflected in both Likert-scale and open-ended responses.

Invited Speaker

STEAM Approach in Teaching Chemistry for Prospective Chemistry Teachers

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ABSTRACT

STEAM learning equips prospective chemistry teachers with 21st-century skills such as critical thinking, collaboration, and creativity, which are essential for designing interactive and relevant learning experiences. This enables them to teach chemistry concepts in an integrated manner with other disciplines, preparing students for complex global challenges. This study aim to determine the learning stages that can enhance the ability of prospective chemistry teachers to understand and design STEAM learning. This study used a classroom action research method with three cycles. The research subjects were 40 prospective chemistry teacher students attending a STEAM learning lecture. Data were collected through content analysis of their worksheets, classroom observations using a rubric, and questionnaires to explore the learning paths and identify possible obstacles. The results showed that the STEAM learning stages, consisting of stage 1: STEAM theory, stage 2: STEAM project, and stage 3: STEAM learning design, were able to improve the ability of prospective chemistry teachers to understand and design chemistry learning with the STEAM approach. However, the exploration of contexts that can be used as cases and the experience of integrating STEAM into their learning design still require more intensive training.

Keywords: *STEAM, chemistry, prospective teacher, classroom action research, models of teaching*

Pesticides as risk factors for DNA damage: human liver cells

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ABSTRACT

Pesticides are often present in mixture in natural environment instead of single compounds. Organophosphate pesticides (OPs) insecticide is one of a group of pesticides that are widely used in the world. Terbufos and fenthion, group of OPs, revealed that both terbufos and fenthion induce DNA damage in human liver cells. Accumulation of OPs in environment impacted cellular DNA double strands breaks (DSBs) through reactive oxygen species (ROS) generation. Therefore, we investigated the effects of terbufos and fenthion on the repair of DSBs while single exposure to human liver cells (HepG2 cells). Some genes and proteins related to homologous recombination (HR) and non-homologous end joining (NHEJ), the major DSBs repairing pathways for DSBs, will be analyzed both in vitro and in vivo. We will focus on several key genes related to homologous recombination (HR) genes (Brca1, Rad51, Rad18, Xrcc2) which was collaborated with the data of HR activity and non-homologous end-joining (NHEJ) (Xrcc6) repair pathways. Our prelimanary data revealed that single exposure of terbufos or fenthion (5 – 40 μM) impaired HR genes and protein. Moreover, protein expression level of phosphorylated H2AX (γH2AX), a marker of DNA double stranded break occurrence, was observed in single exposure to terbufos or fenthion. We thereby suggested that single exposure pesticides support in terms of DNA damage response. To further confirms that the exposure of terbufos or fenthion could cause DNA DSBs using NHEJ repair pathway,responsible for DNA damage. Collectively,terbufos or fenthion caused DSBs in HepG2 cells and zebrafish embryos. High risk of pesticides to individually must be understanding, particularly in education system.

Keywords: *DNA damage, DNA double strands breaks, organohosphate pesticides, education*

SYMPOSIUM

Stress Classification based on Thermal Signature Analysis using AI-driven Models

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ABSTRACT

The proposed approach aims for crop stress classification in tomato plants using thermal imaging and machine learning. While traditional methods rely on detecting changes in water content, they often fail to distinguish specific stress types at early stages. Initially aimed at identifying diseases like mosaic virus and yellow leaf curl, the study expanded to include various stress factors such as nutrient deficiencies, pathogen attacks, and environmental pressures. To address the limitations of conventional techniques, a thermal signature-based classification model is proposed. By analyzing canopy temperature variations captured via thermal imaging, the model detects stress symptoms before visible signs appear. Deep features are extracted using a pre-trained ResNet-50 Convolutional Neural Network, and classification is performed using a Support Vector Machine. The model achieved 98% accuracy, showing promise for integration into real-time agricultural monitoring systems, enabling timely and precise stress detection in crops.

Keywords: *Irrigation Management, Canopy Temperature, CNN ResNet50, Random Forest, Crop Yield.*

Bridging Sustainable Science Education and Culture: The Role of Educational Augmented Reality Media in Ethnoscience and Cultural Literacy

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ABSTRACT

The development of digital-based educational technology presents an opportunity to integrate local wisdom into sustainable science learning. One potential innovation is Educational Augmented Reality (Edu-AR), a media for facilitating the visualization of abstract science concepts within local wisdom, strengthening cultural identity and fostering students' cultural literacy. This study aims to analyze the effect of using Edu-AR in ethnoscience-based sustainable science learning on students' cultural literacy. The research method used was a quasi-experimental design with a non-equivalent control group pretest-posttest model. The study sample consisted of 60 seventh-grade junior high school students, divided into experimental and control groups, selected purposively. The data collection instrument was a cultural literacy test. Data analysis was performed using t-tests and normalized gain (N-gain). The results showed (a) a significant difference in posttest scores between the experimental and control groups, with a significance value of $0.000 < 0.005$, with an average difference of 34.10 points for cultural literacy (88.30 - 54.20); (b) Cultural literacy increased by 0.78 in the experimental group (high category) compared to 0.21 in the control group (low category). These findings indicate that integrating Edu-AR media into ethnoscience-based sustainable science learning can significantly improve students' cultural literacy. The novelty of this study lies in the integration of Edu-AR media into sustainable science and ethnoscience learning. Edu-AR can visualize local cultural representations in a scientific context to strengthen cultural literacy as a bridge for contextualization and develop awareness of cultural sustainability within the framework of citizen science and the SDGs.

Keywords: *Educational Augmented Reality, Ethnoscience, Cultural Literacy, Science Education*

The Effectiveness of the Think Talk Write (TTW) Learning Model on Improving Students' Critical Thinking Skills in Chemical Bonding

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ABSTRACT

Critical thinking skills are 21st-century skills that students must possess in order to keep up with developments in science. However, it has been found that students' critical thinking skills are still relatively low. This is also the case for students in grade 10 at SMA Negeri 8 Samarinda, where students' ability to express reasons and provide logical arguments is still lacking. One of the contributing factors is the use of conventional learning models that do not actively involve students. Efforts to develop critical thinking skills in students can begin with the selection of effective learning models that foster students' thinking patterns, such as the Think Talk Write (TTW) learning model. This study aims to determine the effectiveness of the TTW learning model in enhancing students' critical thinking skills on the topic of chemical bonding. The research method used is a pre-experimental design with a One-Group Pretest-Posttest Design. Data collection was conducted using pretest and posttest assessments. The research subjects were students from class X-4 of SMA Negeri 8 Samarinda, selected using cluster random sampling. Data analysis to assess the effectiveness of the TTW learning model was conducted using the N-Gain test and Effect Size test, preceded by normality tests and paired t-tests. The results of the study indicate that the TTW learning model is effective in improving students' critical thinking skills, with an N-Gain value in the moderate category of 0.59. The effectiveness level of the TTW learning model is in the high category, with an Effect Size value of 3.4. The conclusion of this study is that the TTW learning model is effective in improving students' critical thinking skills.

Keywords: *effectiveness; Think Talk Write (TTW) learning model; critical thinking skills*

Driving Question Formulation in Green Chemistry: A Computational Thinking Approach

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ABSTRACT

Equipping students with the ability to think critically and act sustainably is essential in modern science education. Green chemistry, particularly the principle of *Prevention*, offers a powerful framework for fostering environmental responsibility through proactive design of chemical processes. This study presents a lesson plan that positions the formulation of driving questions as the foundation for learning about pollution prevention in the textile industry. Using a computational thinking (CT) approach, students engage in analyzing environmental problems, decomposing industrial processes, and generating systems-oriented questions that guide further inquiry. The lesson was developed as part of a student worksheet (LKPD) aligned with project-based learning and the Indonesian science curriculum. CT components such as abstraction and pattern recognition are integrated to support students' reasoning. Preliminary implementation shows that students can construct relevant and insightful questions that reflect both environmental awareness and computational logic. This approach highlights the importance of embedding CT in early stages of inquiry to nurture sustainable thinking in secondary science education.

Keyword: Green Chemistry, Prevention, Computational Thinking, Driving Questions, Lesson Plan, Science Education

Profile of Prospective Chemistry Teachers' Knowledge about Green Chemistry: A Cross-Institutional Survey

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ABSTRACT

Green Chemistry (GC) is an important component of 21st-century chemistry education and contributes to achieving the Sustainable Development Goals (SDGs). This study aimed to evaluate the knowledge of prospective chemistry teachers in six teacher education institutions (LPTK) in Indonesia regarding the twelve principles of green chemistry. A total of 328 chemistry education students from six universities participated in this descriptive quantitative survey study. Data were collected using a true–false multiple-choice test consisting of twenty items, adapted from the instrument developed by Zhang et al. (2022). The findings revealed that the participants' overall knowledge level was moderate, with an average score of 75. Approximately 82.87% of respondents correctly answered the item related to the principle of " Inherently safer chemistry for accident prevention" while only 66.67% answered correctly on the principle of "prevention." ANOVA results showed a statistically significant difference in GC knowledge among the universities (F = 7.704; p < 0.01), indicating unequal integration of GC principles into the chemistry education curricula and instructional practices across institutions. These findings highlight the need for systematic integration of green chemistry into chemistry education programs to ensure that future teachers are well equipped to teach environmentally responsible and sustainability oriented science.

keywords: *green chemistry, prospective chemistry teacher, SDGs, teacher education institutions*

Multivariate and Correlational Analysis of Students` Dispositions and Creative Products through STEM-DT-Based Water Filtration Project Learning

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ABSTRACT

Creativity is a key 21st-century skill that must be intentionally fostered in education. However, conventional learning approaches often provide limited opportunities for students to develop creative dispositions and produce innovative, applicable solutions. This study investigates the effect of a STEM-DT (Science, Technology, Engineering, Mathematics-Design Thinking) project-based learning model-focused on water filtration-on students^ creative dispositions and the quality of their creative products. A quasi-experimental design was used, involving 52 junior high school students divided evenly into an experimental group (STEM-DT approach) and a control group (conventional learning). Data were collected through a creative disposition questionnaire and a creative product assessment rubric. MANOVA analysis revealed significant differences between the groups in both creative disposition ($p = 0.040$) and creative product scores ($p = 0.000$). The experimental group showed a higher average disposition score (105.08) compared to the control group (95.27). Creative product performance in the experimental group reached 84.07% (highly creative), while the control group scored only 48.89% (moderately creative). Furthermore, a very strong positive correlation was found between creative disposition and product score (Spearman's $\rho = 0.992$, $p < 0.01$). These results indicate that the STEM-DT approach not only enhances students^ creative potential but also aligns their thinking with tangible, high-quality outcomes. The findings recommend broader application of STEM-DT in science education to prepare students for complex global challenges through contextual and project-based learning.

Improving Critical Thinking Skills of Junior High School Students through the Implementation of STEM-Based IPDBL Model on Additive Substances in the Context of Sustainable Education

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ABSTRACT

This study aims to describe the improvement of critical thinking skills of junior high school students through the implementation of STEM-based Innovative Project Design-Based Learning (IPDBL) learning model on food additives in the context of sustainable education. The learning is designed to integrate contextual learning, sustainability principles, and STEM approaches through a solution-based project on the issue of using synthetic additives. This research begins with the development of the STEM-based IPDBL learning model and its supporting tools and its implementation in a limited trial with grade VIII students at Sekolah Indonesia Kuala Lumpur. The IPDBL model was developed in seven phases based on the engineering design process and trained critical thinking skills. The validity of the developed learning model was determined using a validation sheet, while the effectiveness of the learning model in improving critical thinking skills was determined using a critical thinking skills test. The results showed that the learning model and learning tools developed were categorized as highly valid (average Aiken score = 0,96). Based on the analysis of the results of the critical thinking skills test, the n-gain value was 0,55 with the category medium. From the results of the paired t-test, the value of p = 0.000 was obtained, which indicated a significant difference between the pre-test and post-test scores. These findings indicate that the STEM-based IPDBL model is effective.

Integration of Technological Pedagogical and Content Knowledge in the Mathematics Learning Assessment Course: Strategies to Encourage Critical Thinking and Prepare Prospective Teachers to Face 21st-Century Challenges

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ABSTRACT

The Technological, Pedagogical, and Content Knowledge framework is an essential foundation in preparing prospective teachers to face the complexities of 21st-century learning. This study aims to describe the integration of the technological, pedagogical, and content knowledge framework in prospective mathematics teacher students, in order to foster critical thinking skills in the students they teach. The approach used was descriptive qualitative, using observational analysis techniques of microteaching and video recordings implemented in the mathematics learning assessment course. The data collected were conducted by observers using field notes and structured observation guidelines to identify the application of technological, pedagogical, and content aspects, as well as the strategies used by prospective teachers to stimulate critical thinking in their students. The analysis revealed that the majority (85%) of prospective teachers successfully integrated technological, pedagogical, and content knowledge components in implementing lessons that stimulate critical thinking in their students, although there was variation in the effectiveness of the strategies employed. These findings provide an overview of the readiness of prospective mathematics teachers in implementing learning that integrates Technological Pedagogical and Content Knowledge that is in line with the demands of 21st century education.

Cultural Context in Science Education: Improving Scientific Literacy through Batik Tanjung Bumi

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ABSTRACT

Scientific literacy is a thinking skill that should be developed from an early stage of education, especially in relation to science knowledge. It enables students to understand and solve various science-related problems in their daily lives. This study aims to describe students' scientific literacy after participating in science learning that integrate the local cultural context of Batik Tanjung Bumi. This study employed a descriptive quantitative method with 21 participants, using a one-group pretest-posttest design. A test of scientific literacy was used to gather data. The Wilcoxon test showed that the difference between the pretest and posttest scores was significant, with a significance value of less than 0.05. The average N-gain score was 0.39, which is a moderate improvement. These findings suggest that incorporating Batik Tanjung Bumi into science learning can effectively enhance students' scientific literacy. Moreover, the cultural product context of Batik Tanjung Bumi can be replicated and adapted to enhance the development of other thinking skills.

Characterization of HiMedia Commercial Papain Enzyme and Implications for STEM-based Sustainable Education

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ABSTRACT

Papain is a cysteine protease widely applied in the food, pharmaceutical, and cosmetic industries due to its proteolytic activity under mild conditions. In Indonesia, commercial papain from HiMedia Laboratories (India) is extensively used, its biochemical profile remains undocumented yet. Comprehensive characterization is essential to optimize its usage and to integrate enzyme-based learning in sustainable STEM education. Prior studies have highlighted the importance of enzyme stability and kinetics for industrial scalability and education relevance. This study aims to characterize HiMedia papain in terms of temperature and pH optima, kinetic parameters (Km and Vmax), and purity. The enzyme exhibited maximal activity at 60 °C (9.007 ± 0.328 U/mL), with only a 7.21% decrease at 70 °C, indicating thermostability. Optimal activity was observed at pH 6.0 (8.660 ± 0.575 U/mL), with activity declining at more acidic or alkaline conditions. Kinetic analysis revealed a Km of 0.335 mg/mL and a Vmax of 1.678 mg/mL·min. SDS-PAGE analysis showed a single dominant band, suggesting high purity. These findings indicate that HiMedia papain is thermostable, active in neutral pH, and catalytically efficient, making it suitable for various industrial applications, particularly in the food sector. Moreover, this study provides a scientific basic for integrating enzyme characterization into interdisciplinary STEM learning frameworks to promote sustainability through hand-on biochemistry and green technology applications.

Keywords: *commercial papain, enzyme characterization, green catalyst, STEM, sustainability, interdisciplinary approach*

Comparative Effectiveness of Lecture-Based and Presentation-Review Learning Methods in Enhancing Student Outcomes in Basic Biology Courses

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ABSTRACT

This study comparatively investigated the effectiveness of lecture-based and presentation-review learning methods in enhancing student outcomes in Basic Biology courses. Two groups of students participated: Group C (non-summarized), exposed to the conventional lecture method, and Group D (summarized), utilizing a presentation-review method that involved students in summarizing the learning material. Pretest and posttest scores, N-gain values, and conceptual accuracy per topic were analyzed to evaluate the improvement in understanding. Results indicated that both methods led to an improvement in learning outcomes, yet the lecture-based method (Group C) yielded a higher overall average N-gain of 0.396 compared with the presentation-review method (Group D) at 0.220. Furthermore, Group C consistently demonstrated higher average question accuracy across all tested biology topics, including "Biology, and Scientific Inquiry" (66.83% compared to 57.50%), "THE CELL" (61.13% compared to 57.38%), "Genetics" (63.67% compared to 61.00%), "MECHANISMS OF EVOLUTION" (51.70% compared to 47.50%), and "EVOLUTIONARY HISTORY OF BIOLOGICAL DIVERSITY" (61.10% compared to 51.60%). These findings offer significant implications for curriculum design and teaching strategies in Biology education, underscoring the importance of considering both material characteristics and appropriate instructional methods.

Science Teachers' Perceptions of Integrating Sustainability Education into STEM Based Deep Learning in Junior High Schools in West Nusa Tenggara

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ABSTRACT

This study aims to explore science teachers' perceptions of integrating sustainability education into STEM-based learning in junior high schools, with a particular focus on fostering deep learning. The integration of sustainability concepts into science, technology, engineering, and mathematics (STEM) education is crucial to equipping students with critical thinking, problem-solving skills, and environmental awareness. This research employed a descriptive quantitative approach involving 45 science teachers from junior high schools in West Nusa Tenggara Province, selected using purposive sampling techniques. Data were collected through a Likert-scale questionnaire developed based on four dimensions: understanding of sustainability, attitudes toward sustainability integration within STEM learning, perceived competence in designing deep learning activities, and perceived implementation barriers. The findings reveal that teachers generally hold positive perceptions of the importance and relevance of sustainability education in STEM-based instruction. However, several challenges were identified, including limited training opportunities, lack of learning resources, and curriculum constraints. These results highlight the need for targeted professional development and institutional support to strengthen teachers' capacity in implementing sustainability-oriented deep learning in science education at the junior high school level.

Keywords: *teacher perception, sustainability education, STEM learning, deep learning, science education, junior high school*

Zulqifli Alqadri (Universitas Negeri Makassar)

Development of LKPD based on Socio-Scientific Issues Using the "Penyu Kita" Application to Increase Students' Environmental Awareness, Attitudes, and Behavior

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ABSTRACT

Environmental awareness, attitudes and behaviors are strategies to improve the environment for the better. This study aims to increase students' awareness, attitudes and behavior by using LKPD media based on socioscientific issues on the life problems of sea turtles. The instruments used include pretest posttest and response questionnaire of students' environmental attitudes and behaviors. Research with a pre-experimental design using a sample of 51 students. Data analysis techniques using normality test, Wilcoxon and N-Gain. The results of this study indicate an increase in awareness, attitudes and environmental behavior with the LKPD media used quite effectively.

Keywords : *environmental awareness, environmental attitude, environmental behavior*

Bringing Plants into Focus: Enhancing Middle Schoolers' Plant Awareness through Cooperative Learning

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ABSTRACT

This pre-experimental study aims to test the effectiveness of applying the window shopping type cooperative learning model in increasing plant awareness in grade VII junior high school students in the context of ecology and biodiversity learning. A total of 57 students from one of the junior high schools in Malang, East Java participated in this study. Data was collected through pretest and posttest learning outcome tests, plant awareness questionnaires, and image-based visual perception instruments with visual dominance of animals and plants. The results of the analysis showed a statistically significant improvement in student learning outcomes after learning, the average questionnaire score showed the tendency of students in visual attention and positive attitudes towards plants. Visual perception data showed that learning interventions were able to change students' attention that was previously more dominant in animal images to be more balanced and even increased towards plants images. These findings indicate that the integration of visually appealing and experiential learning strategies in biodiversity education has a positive impact on improving plant awareness.

Implementation of PBL (Problem Based Learning) To Improve Students' Scientific Literacy On Nutritional Status Measurement Material

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ABSTRACT

In 21st century learning, students are expected to master various important skills to adapt to the rapid development of the times. One of these skills is scientific literacy. The purpose of this study is to improve the level of scientific literacy in junior high school students, especially on the topic of measuring nutritional status in Indonesia. This study used a pre-experiment method involving students in grades VII-1 and VII-4 at SMPN 21 Malang as samples. The instruments used included a pretest and posttest designed to measure students' scientific literacy level. The learning process used the Problem Based Learning (PBL) model. Based on the results of the study, the level of scientific literacy of students is classified as moderate. The indicator that shows the highest improvement is ability to research, evaluate, and use scientific information for decision-making and action. In second place is explaining phenomena scientifically, and in third place is building and evaluating designs for scientific investigations and critically interpreting scientific data and evidence.

Development Of Teaching Modules For Redox Concepts and Electrochemical Cells Using LC-5E With The Context Of Socio Scientific Issues and Sustainable Development Goals-Clean And Affordable Energy

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ABSTRACT

Industrialization and population growth increase energy needs, especially electricity with dependence on fossil energy sources that produce CO_2 emissions, damage the environment, and threaten health that can be resolved with sustainable development goals and can be achieved through education for sustainable development (ESD). This study aims to develop teaching modules for redox concepts and electrochemical cells using LC-5E with Socio Scientific Issues context and Sustainable Development Goals-Clean and Affordable Energy and to determine students' understanding of Sustainable Development Goals-Clean and Affordable Energy before and after being given teaching modules. This research is a development research using the ADDIE model and limited trials using pre-experimental research methods with one group pretest-posttest design using instruments in the form of interview guidelines and questionnaire sheets. Data analysis techniques using descriptive qualitative and statistical. The results of the development are in the form of teaching modules for redox concepts and electrochemical cells in the form of printed media equipped with specific learning objectives, SDGs targets and indicators, using socioscientific issues related to SDGs-clean and affordable energy, and containing ESD key competencies. The teaching module developed obtained "very valid" criteria from expert and practitioner validators and readability tests, so that this teaching module is suitable for use in learning. In addition, there is a significant difference and a big influence on the understanding of students before and after being given the teaching module with the N-Gain value in each question domain getting high and medium. This research has implications that students' understanding of SDGs needs to be made explicit through learning activities and for further research, the implementation of the modules that have been developed.

Development and Validation of an ICT-Based TPACK Test for Pre-Service Science Teachers: Toward Objective and Scalable Assessment

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ABSTRACT

Technological Pedagogical Content Knowledge (TPACK) is a crucial framework for evaluating teachers' ability to integrate technology, pedagogy, and content in the learning process. This study responds to the need for an objective and valid assessment tool to measure the TPACK competence of pre-service science teachers, given that existing instruments are mostly based on self-assessment questionnaires, which are prone to subjectivity and bias. This research aims to develop a valid, reliable, and widely accessible ICT-based TPACK test instrument. The development followed the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The initial phase involved literature reviews and interviews with program heads of science education at six teacher training institutions (LPTK). The resulting instrument comprises 68 multiple-choice questions covering the seven TPACK components (CK, PK, TK, PCK, TCK, TPK, and TPACK). Content validation by five experts yielded an Aiken's V score of ≥ 0.87, with an overall value of 0.93. The instrument was tested on 241 pre-service science teacher students at four major teacher training institutions (UNNES, UPI, UNY, and UM). Rasch analysis and KR-20 reliability testing showed that the instrument is highly reliable and has a balanced level of difficulty. The integration of ICT enables the instrument to be administered online, making it practical and efficient for geographically dispersed regions such as Indonesia. This research contributes to innovations in educational assessment and to improving the quality of science teacher education.

Keywords: *TPACK, test instrument, ICT, pre-service science teachers, teacher competence, educational innovation*

Analysis of TPACK Components and Critical Thinking Indicators in Teaching Materials Developed by Prospective Mathematics Teachers

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ABSTRACT

The ability to integrate technology, pedagogy, and content knowledge (Technological Pedagogical Content Knowledge/TPACK), as well as design learning that fosters critical thinking, is a crucial competency for prospective mathematics teachers (PMT). This study aims to analyze teaching materials developed by PMT, focusing on identifying TPACK components and critical thinking ability indicators. The approach used is descriptive qualitative with document analysis techniques. Data was obtained from teaching materials, including lesson plans, student worksheets, digital media, assessment instruments, individual portfolios, and videos of teaching practice by students. The analysis instrument was developed based on TPACK elements and six critical thinking indicators according to Facione: interpretation, analysis, evaluation, inference, explanation, and self-regulation. The results show that all PMTs included the three TPACK components in their materials, with dominance in the pedagogical and content aspects. The technology component was also functionally used, particularly in digital assessments, although the higher-order thinking skills (HOTS) dimension in those assessments was not fully explored. The critical thinking indicators were most represented in the questions based on the Minimum Competency Assessment developed by the PMTs, particularly in the analysis and interpretation aspects, but did not fully cover all critical thinking skills such as self-regulation and deep inference. These findings provide important insights for strengthening integrated TPACK literacy and critical thinking skills in the learning and education of prospective mathematics teachers.

Keywords: *teaching material, TPACK, critical thinking, prospective mathematics teacher*

Application of Physics Learning Management in Classroom Action Research with STEM Integrated Motion Kinematics Material to Improve Literacy Skills

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ABSTRACT

This study aims to improve the literacy skills (reading and writing) of Grade XI students at Public High School 3 Bekasi, Indonesia by using physics learning management within the framework of motion kinematics. Conducted as a classroom action research implemented in two cycles, each involving stages of planning, implementation, observation, and reflection—this study involved 35 students in Grade XI-4 during the 2024/2025 academic year. After the initial cycle, 27.78% of students demonstrated literacy skills, and 38.89% achieved a high level of proficiency in using their literacy skills. The second cycle resulted in a marked increase, with 36.61% of students meeting the indicators of competent use of literacy skills, and 47.22% achieving a high level of proficiency. The result of hypothesis test in this research which conducted with a Z-statistic of 50.1170 > 1.645 as Z-table, so the hypothesis was accepted, meaning that the application of physics learning management in classroom action research with stem integrated motion kinematics material can improve literacy skills, as reflected in an N-gain score of 0.82, categorized as high.

Implementation of the Project Based Learning (PjBL) Model on Measurement Topic to Improve Students' Collaboration Skills

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ABSTRACT

The purpose of this research is to improve collaboration skills in the topic of measurement through the PjBL model. Indicators of collaboration skills include active participation, productive engagement, adaptability, willingness to compromise, responsibility, and mutual respect. This research was conducted in Grade X at Public High School 61 Jakarta, Indonesia, involving 36 students. Data were collected through tests, interviews, and observations. The method used was classroom action research, consisting of planning, implementation, observation, and reflection stages. The study was conducted in two cycles. In Cycle I, 3 students (8.33%) were unable to collaborate, 5 (13.89%) were quite capable, 16 (44.45%) were capable, and 12 (33.33%) were very capable. In Cycle II, 2 students (5.55%) were unable, 4 (11.11%) were quite capable, 14 (38.89%) were capable, and 16 (44.45%) were very capable of collaborating. The hypothesis was accepted as the z-count exceeded the z-table (27.3745 > 1.645), indicating that the PjBL model significantly improved students' collaboration skills in the measurement topic. The N-gain score was 0.64, which is categorized as high.

Interactive Project-Based Learning MODULE in Cosmetic Chemistry: Enhancing Practical Skills and Self-Efficacy Among Pre-Service Chemistry Teachers

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ABSTRACT

This study explores the effect of an interactive Project-Based Learning (PjBL) module on the practical skills and self-efficacy of pre-service chemistry teachers at The States University of Yogyakarta. The module, focused on cosmetic chemistry, was validated by experts and tested in a pilot study to ensure its effectiveness. A quasi-experimental design was used, with participants randomly divided into an experimental group using the module and a control group receiving traditional instruction. Practical skills and self-efficacy were assessed using standardized tools. Findings showed significant improvements in the experimental group compared to the control group, with p-values less than 0.000 for both outcomes. Effect size analysis using Cohen's d indicated a large impact on practical skills ($d = 1.24$) and self-efficacy ($d = 1.35$). These results demonstrate the module's strong potential to enhance hands-on skills and confidence in pre-service chemistry teachers, supporting the integration of PjBL in teacher education.

An Analysis of the Relationship Between TPACK Understanding and Practical Experience in Misconception Remediation from the Perspective of Science Teachers' Gender

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ABSTRACT

The process of conventional misconception remediation in science education has been carried out since the 1980s, but the use of technology began in the 2000s. In recent years, the integration of technology into science learning has become increasingly prevalent and well-structured, encompassing the framework of Technological, Pedagogical, and Content Knowledge (TPACK). However, the involvement of TPACK in addressing misconception remediation remains a relatively underexplored area of study. This study examines the relationship between TPACK understanding and experiences in misconception remediation from the perspective of science teachers' gender. The data analysis reveals that science teachers' basic understanding of the TPACK concept is still very low, and most of them are in need of training related to TPACK. In general, there is a strong correlation between TPACK understanding and misconception remediation experience, both for male and female science teachers. However, there are several differing indicators that require in-depth analysis.

Problem Solving Ability In Classroom With Asicc Learning Model

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ABSTRACT

Problem-solving skills are one of the thinking skills required in 21st-century learning. Problem-solving skills are the basic process of identifying problems, considering options, and making informed choices. Therefore, this study aimed to improve these skills through quasi-experimental research using a non-equivalent pre-post test control group design by comparing two classes of 75 students enrolled in a general biology course. The experimental class was taught using the ASICC model, while the control class was taught without the ASICC model. The research instrument used was an integrated essay test of problem-solving skills that referred to indicators of understanding problems, analyzing problems, formulating solutions, and formulating action plans. The instrument used was validated and declared valid and reliable. The data obtained were then analyzed descriptively and inferentially using t-tests, which were previously preceded by homogeneity and normality tests. The results of the study showed that descriptively, there were changes in problem-solving thinking skills based on their categories. The ASICC model was able to change the low category into medium and high categories with a larger percentage compared to the control class. The results of the t-test also showed that there was a difference between the experimental class and the control class in problem-solving abilities. This study indicates that the ASICC learning model can be used as an alternative learning model that can improve students' problem-solving abilities.

Keywords: *21st century education, ASICC model, problem solving skills*

The integration of traditional values in sustainable chemistry education: An idea

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ABSTRACT

This study is based on the urgency to reorient chemistry education, which has traditionally focused on cognitive aspects, toward more contextual, meaningful learning rooted in cultural values and environmental sustainability. Data sources were obtained from relevant scientific articles and books and analysed using Miles & Huberman's qualitative analysis. The analysis results indicate that local Indonesian traditions such as Nyadran (Java), Subak (Bali), Sasi (Maluku and Papua), and Mapalus (Minahasa) contain ecological, social, and spiritual values that align with the principles of green chemistry and sustainable education. These four traditions can be used as a source of chemistry learning by integrating traditional values with high school chemistry materials such as electrolyte solutions, redox reactions, acids and bases, colloidal systems, thermochemistry, and environmental chemistry. This integration not only strengthens students' conceptual understanding but also builds ecological awareness, cultural character, and scientific ethics. These findings confirm that the ethnochemistry approach, which highlights local values as a learning context, is an innovative strategy for creating inclusive, relevant, and sustainable development-oriented chemistry education. The results of this study provide theoretical contributions to the development of transformative chemistry education and can serve as a starting point for teachers and curriculum developers to design teaching materials based on local wisdom within the context of 21st-century science education.

Generative AI in Science Education: A Meta-Analysis of Its Effectiveness and Contextual Moderators

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ABSTRACT

Generative AI (GenAI) is rapidly reshaping science education by offering dynamic, personalized, and inquiry-driven learning experiences. This meta-analytic study synthesizes empirical findings from peer-reviewed articles indexed in Scopus to evaluate GenAI's impact across diverse educational levels and scientific domains. Using PRISMA methodology and random-effects modelling, the analysis reveals a large overall effect size (SMD = 0.93), affirming GenAI's capacity to enhance learning outcomes. Subgroup analyses highlight significant variations: GenAI is most effective in higher education and physics, particularly when used for task-oriented learning, while negative effects emerge in senior high school and chemistry contexts. These findings underscore the importance of pedagogical alignment, ethical integration, and contextual adaptation. As GenAI continues to evolve, this study offers critical insights for educators, researchers, and policymakers seeking to harness its potential responsibly. Future research should explore domain-specific strategies and long-term impacts to guide equitable and effective GenAI adoption in science classrooms.

Science Identity and Science Mindset: How They Predict Student' Critical Thinking in Additive and Addictive Substances

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ABSTRACT

This study investigated the relationship between science identity, science mindset, and students' critical thinking skills on additive and addictive substances. This descriptive and correlational study involved 50 students from a private secondary school in Malang, East Java, Indonesia. Data analysis was carried out using descriptive and inferential statistical techniques such as Spearman's rho test and simple linear regression test to determine the relationship in each variable. This study found a positive correlation between science identity and science mindset with a coefficient value of 0.522; science identity and critical thinking skills with a correlation coefficient of 0.616; and between science mindset and critical thinking skills with a correlation coefficient of 0.623. These values confirmed the positive relationship between the three variables.

West Sumatra's Natural Potential for Studies in Education and Geophysical Sciences

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ABSTRACT

West Sumatra is a region rich in geological phenomena, such as tectonic activity, including active Sumatran faults, tectonic lakes, and volcanic activity. These phenomena create a unique and dynamic geological landscape that requires geophysics to study. This diversity is not only important in the context of disaster mitigation and natural resource exploration, but also holds strategic value as teaching materials and research objects in education and geoscience. This paper aims to examine the potential of West Sumatra's natural resources as educational and research resources, based on previous research and a literature review in the fields of geophysics and education. The method used is a literature review with a descriptive-qualitative approach, reviewing scientific publications related to geological structures, tectonic dynamics, and environment-based learning approaches. The results indicate that areas such as Lake Maninjau, Lake Singkarak, Sianok Canyon, Mount Marapi, and the Harau Valley have high potential as natural laboratories to support contextual learning and interdisciplinary research. Integrating this natural potential into the curriculum can improve the quality of locally based education and encourage the strengthening of field research. Furthermore, the area has the potential to become an open natural laboratory for academic research, conservation, disaster mitigation, and educational tourism. This research recommends the development of learning models and educational policies that support the educational and sustainable use of the natural environment.

Keywords: *geophysics, environmental education, West Sumatra, natural potential, natural laboratory*

Exploring the Potential of the Miswak Tradition as a New Idea for Green Chemistry-Based Chemistry Learning

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ABSTRACT

Education needs to improve students' abilities to become culturally aware agents in facing future challenges. The current curriculum has not optimized the use of cultural values to facilitate learning. This is partly due to cultural diversity, making it difficult to provide culturally integrated learning content in a fair manner. The optimal utilization of cultural values can facilitate learning, such as making chemistry more contextual. This study aims to provide new ideas in writing about the tradition of miswak as culturally integrated learning content that supports the principles of green chemistry. This literature review is based on credible, up-to-date, and relevant sources related to the research topic, providing an overview of the issue, evaluating various perspectives, and presenting new ideas obtained. The data in this study are secondary data from various databases such as Scopus, Google Scholar, ERIC, and others. The inclusion criteria established include: (1) Research on the topics of ethnochemistry and miswak, (2) Original Research, full text, and open access, and (3) internationally/nationally indexed. The tradition of miswak has various potential values in the fields of health, religion, culture, and economics, and supports the Sustainable Development Goals (SDGs) and the principles of green chemistry. In this study, the tradition of miswak is linked to green chemistry materials in sustainable development 2030, acids and bases, and benzene derivatives in green chemistry-based chemistry learning practices. The new findings are expected to increase the availability of content in the education curriculum and provide green chemistry-based chemistry learning that is integrated with culture in learning activities.

Keywords: *chemistry education, etnochemistry, miswak, green chemistry*

Analysis of School Readiness in Implementing Chemistry Education for Students with Physical Disabilities in Senior High Schools in Malang City

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ABSTRACT

This study aims to determine the level of readiness of senior high schools in Malang City in implementing chemistry learning for students with physical disabilities, in terms of curriculum, teaching staff, and infrastructure. Education is the right of all citizens, including people with disabilities, which can be realized through inclusive education. Chemistry lessons in high schools are considered challenging and require physical activities such as laboratory experiments, making it crucial to assess schools' readiness within an inclusive context. The study was conducted using a descriptive approach with a case study design. The study was conducted at 47 public and private high schools over three months, with subjects including school principals, chemistry teachers, and peers of students with physical disabilities. Data was collected through online questionnaires and offline interviews. Data analysis involved data reduction, data presentation, and drawing conclusions, with credibility tested using triangulation of sources. This study revealed that the majority of high schools in Malang City are not yet ready to implement inclusive chemistry learning for students with physical disabilities. In terms of curriculum, most schools do not accept students with special needs, do not conduct special assessments, and do not have a structured PPI team or method. Specialized curriculum are not yet available, although some schools have attempted modifications. In terms of teaching staff, most teachers have not received inclusive training, and Special Education Assistants (SEAs) are not yet available. Regarding facilities and infrastructure, laboratory facilities and classroom accessibility do not yet support the needs of students with physical disabilities.

Comparative study: Optimisation of portable reactor biogas production utilising cattle farm waste with the addition of EM4, tape yeast, and papain enzyme

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ABSTRACT

Biogas is a gaseous energy produced from the anaerobic activity of organic materials such as livestock manure, biodegradable waste, and production residues involving organic materials. Biogas has great potential as a renewable and environmentally friendly energy source. Cattle manure waste is one of the abundant sources of biomass and has great potential as an environmentally friendly alternative energy source. Optimising biogas production and quality remains a major challenge, especially in the context of household-scale utilisation. This study aims to investigate the comparison of biogas production with the addition of bioactivator EM4, tape yeast, and papain enzyme on the volume and quality of biogas produced from cattle manure. The research method used a portable fixed dome digester with a capacity of 30 litres, with four treatment variations: P1 (cow manure + EM4), P2 (cow manure + papain enzyme), P3 (cow manure + tape yeast), and P4 (cow manure + combination of tape yeast and papain enzyme). The fermentation process lasted for 50 days, and tests were conducted on biogas volume, flame colour, and lime water test results. The results showed that treatment P1 produced the highest biogas volume of 22,890.6 cm^3 with a red flame. Meanwhile, treatment P2 showed a blue flame in the combustion test, indicating optimal combustion quality. The lime water test on all treatments showed turbid results, indicating the presence of CO_2. This study demonstrates that the addition of bioactivator materials significantly influences the volume and quality of biogas from cow manure, thereby reinforcing the potential for the application of simple biogas technology as a sustainable energy solution at the community level.

Keyword: *biogas, anaerobic, cow manure, renewable energy, bioactivator, papain enzyme*

Implementation of Field Trip and Chemis-Tea (Chemistry in Tea) Interactive Media to Improve Students' Scientific Literacy Skills as a Form of Non-Formal Learning in Wonosari Tea Agrotourism

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ABSTRACT

In the 21st century, science literacy is a competency that must be developed through various approaches, one of which is through field trips to Wonosari tea agro-tourism as a form of non-formal learning. This study aims to test the effectiveness of Chemis-tea interactive media in improving students' science literacy skills. Chemis-tea media is designed to link chemical concepts, such as compounds and addictive substances contained in tea, the processing of tea plants to become tea that is ready for consumption involving oxidation and fermentation reactions. In addition, it also examines the process of making tea drinks involving physical and chemical changes, as well as additives added in tea drinks. The method used in this research includes the media development stage which is carried out through needs analysis, designing science literacy-based content, and making contextual and applicable Chemis-tea interactive media. Furthermore, the media validation test stage will be carried out and then tested on junior high school students to obtain the results of the response questionnaire. Interim results show that Chemis-tea media has strong potential as an interactive learning media that supports contextualised science learning in non-formal settings. This research is expected to be continued to the trial and effectiveness evaluation stage to prove that Chemis-tea interactive media is effective as a non-formal educational tool that supports hands-on experiential science learning.

Keywords: *Chemis-tea, scientific literacy, interactive media, non-formal learning, wonosari tea agrotourism*

A SYSTEMATIC REVIEW: SOCIO-SCIENTIFIC ISSUE WRITING ACTIVITY THROUGH PROBLEM BASED LEARNING FOR ENHANCING STUDENTS' SCIENTIFIC LITERACY ON COVID-19 TOPIC

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ABSTRACT

The purposes of this study are to analyze the implementation of socio-scientific issue, writing text on socio-scientific issue, and Problem Based learning on enhancing students' scientific literacy and to make learning framework of socio-scientific issue learning based on writing activity through problem based learning for enhancing students' scientific literacy on COVID-19 topic. A systematic literature review was conducted on October 2021 to May 2022. This study includes a literature review of relevant research on the topic of socio-scientific issue based learning, writing text on socio-scientific issue, scientific literacy, problem based learning, and COVID-19 topic. In the beginning, there were 1,987,900 articles about socio-scientific issue based learning, writing text on socio-scientific issue, scientific literacy, problem based learning, and COVID-19 topic. After the screening process based on inclusion and exclusion criteria, there were 23 selected papers in this study. The result showed that it had been found that learning activity based on socio-scientific issue, writing text on socio-scientific issue, and Problem Based Learning has good impact on students' scientific literacy. So, based on that result, a learning framework based on socio-scientific issue through problem based learning with writing activity was created. The indicators of scientific literacy that had been synthesized are identify and find a valid scientific arguments, designing scientific investigation, finding solution and make decision with scientifically reasoning. While, the socio-scientific issue learning steps which are proper to Problem Based Learning that had been synthesized are student engage with issue, student engage with science context of the issue, values exploration, ethical decision and justification, evaluation.

Bridging Indigenous Knowledge and Environmental Literacy: A Bibliometric Analysis of Global Research Trends (2016-2025)

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ABSTRACT

Environmental literacy has become increasingly critical in addressing contemporary environmental challenges, while indigenous knowledge systems offer valuable perspectives on sustainable human-environment relationships. This study presents a comprehensive bibliometric analysis examining the integration of indigenous knowledge and environmental literacy in global research from 2016-2025. Using Scopus database, we analyzed 156 peer-reviewed articles in social sciences through descriptive analysis, citation analysis, and co-occurrence network visualization using VOSviewer. Results reveal substantial publication growth, with major contributions from the United States (24.3%), Australia (15.7%), and Canada (14.2%). Co-occurrence network analysis identified five key thematic clusters: pedagogical approaches (47 occurrences), knowledge systems integration, climate change adaptation, conservation and biodiversity, and policy governance. Temporal analysis demonstrates evolution from knowledge documentation (2016-2018) to curriculum integration and pedagogical innovation (2019-2021) and policy implementation (2022-2025). Place-based education emerged as the central pedagogical approach with highest network centrality, while significant gaps were identified in culturally appropriate assessment methodologies (comprising only 4.2% of all terms) and longitudinal impact studies (87.2% of studies covered less than two years). The analysis reveals critical implications for science education curriculum development and teacher preparation programs, highlighting the need for methodological frameworks that respect epistemological diversity while maintaining academic rigor. This study provides evidence-based directions for developing more inclusive science education approaches that meaningfully integrate diverse knowledge systems.

Keywords: *Environmental literacy, Indigenous knowledge, Bibliometric analysis, Science education, Knowledge integration*

Development of climate change on global warming e-module integrated PBL Model for independent curriculum learning

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ABSTRACT

Purpose of the study was to determine the validity and practicality of the e-module by integrating the PBL model on climate change on global warming. The research method can be included in the research and development group. Model Hannafin and Peck was applied in designing and developing an e-module integrated the PBL model. The development of the e-module integrated PBL model consists of three phases, namely needs analysis, design, and development and implementation. The data collection instrument is a questionnaire sheet for the validity test and practicality test of the e-module integrated PBL model. Based on the data analysis, the results of the study can be stated as follows. First, the validity value of the e-module integrated PBL model can be included in the high category with an average value of 0.85 on the material substance, visual communication display, learning design, software utilization, and PBL model integration indicators. Second, the practicality value of using the e-module integrated PBL model can be classified into a high category with an average value of 87.52 on the indicators of useful, easy to use, appealing, clear, and low cost. Thus, the climate change on global warming e-module integrated PBL model provides good potential to be applied in independent curriculum learning to promote students' 21st century skills.

High School Students' Perspektive on the Gender of Chemistry Teacher in Malang City

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ABSTRACT

This study aims to determine the perspective of high school students in Malang City on the gender of chemistry teachers in the aspects of perception, interest, and learning motivation. The research method used a descriptive quantitative approach with a survey of 592 students from 15 high schools (public and private) selected through convenience sampling. Data were collected through a Likert scale questionnaire (40 items) that had been validated by experts (CV = 0.9) and tested for reliability (percent agreement 90%), complemented by semi-structured interviews to deepen the findings. Data were analyzed using descriptive statistics by calculating the frequency distribution and percentage of student responses. The results showed that the majority of students were neutral towards teacher gender, with pedagogical competence and teaching methods considered more influential than gender identity. However, there was a trend towards a positive preference for female teachers in teaching style (45.5% agreed) and interaction (41.5% agreed), which were considered more expressive and responsive. In addition, a trend was found where students were more motivated when taught by teachers of the same gender. The implications of the study emphasize the importance of improving teachers' competencies and inclusive learning strategies, as well as the need for professional qualifications-based recruitment policies to create an optimal learning environment.

Keywords: *Teacher Gender; Student Perspective; Chemistry Learning; Inclusive Learning.*

Development of Interactive E-Module to Improve Students Creative Thinking Skills in Mixture Materials

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ABSTRACT

This study aims to develop an interactive e-module that is valid and implementable to help improve students' creative thinking skills in mixture materials. This developmental study utilizes the 4D model from Thiagarajan et al. (1974). This study involved 60 eighth grade students from SMP Negeri 1 Karangploso using a convenience sampling technique, and used nonequivalent control group design method. Descriptive analysis techniques were used to explain the pretest-posttest results, an independent sample T test was used to analyze differences in creative thinking ability between the experimental and control groups, and an N-Gain test was used to determine improvement categories in creative thinking ability. Media and material validation result from expert validators and educators showed agreement with almost perfect categories. The T-test results of the posttest values of both groups were less than 0.05, indicating a significant difference in creative thinking ability between the two groups after learning. The experimental group's N-Gain value was higher than the control group, at 0.5021, which means that students increased their creative thinking skills with a moderate category, while the control group only achieve a score of 0.1551 in the low improvement category. Based on these findings, it is known that learning mixture materials using interactive e-modules in experimental classes has been proven effective in improving students' creative thinking skills.

Students' Conceptions of Chemical Bonding: A Needs Assessment Study

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ABSTRACT

Chemical bonding is a core topic in secondary school chemistry curricula, yet its abstract nature poses significant challenges for students. This study aims to identify students' conceptions and learning needs related to chemical bonding through a needs analysis approach. Data obtained from student interviews indicate varying levels of conceptual understanding. While students demonstrated reasonable proficiency in interpreting covalent bonds, fundamental misconceptions persist, particularly regarding basic definitions and complex structures such as NH_3BF_3. The results highlight a gap between expected competencies and actual student understanding. This analysis offers valuable insights for designing targeted instructional strategies and developing context-based teaching materials to enhance conceptual mastery in chemical bonding.

Keywords: *chemical bonding, needs analysis, student conceptions, chemistry education, instructional design*

Assessing Problem-Solving and Academic Writing Skills of Chemistry Students: A Preliminary Study for PLISTEAM-ViRal Model Development

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ABSTRACT

This study explores chemistry students' problem-solving and academic writing skills as a preliminary analysis for developing the PjBL-STEAM embedded VR model (PLISTEAM-ViRal). Twenty-four fourth-semester students from Yogyakarta State University, Indonesia, received direct instruction and were assessed. Problem-solving skills were measured using a Likert scale (1-5) across four aspects: problem identification, planning, execution, and evaluation, while academic writing skills were evaluated on a 100-point scale through article writing. Students excelled in problem identification *(Median = 4, Mode = 4, SD = 0)* but struggled with planning *(Median = 2.5, SD = 0.51)*, execution *(Median = 3, SD = 0.49)*, and evaluation *(Median = 3, SD = 0.51)*, revealing gaps in structured problem-solving strategies. Writing assessments showed moderate proficiency *(Mean = 63.08, SD = 5.55)*, indicating difficulties in scientific articulation and organization. A weak, non-significant correlation *(ρ = 0.191, p = 0.372)* suggests these skills develop independently. These findings highlight the need for an integrated learning model that enhances both competencies. The proposed PjBL-STEAM embedded VR model aims to bridge these gaps by promoting active engagement, collaboration, and immersive learning experiences in chemistry education.

The Effect of Problem Based Learning (PBL) on Students' Environmental Literacy on Ecology and Biodiversity Materials

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ABSTRACT

The purpose of this study is to explain the influence of Problem Based Learning on the Environmental Literacy of students of ecology and biodiversity materials. The researcher uses a type of experimental research (quasi experiment design). The sampling technique taken was a purposive sampling technique obtained from students of class VII A (N = 32) which is an experimental class by applying Problem Based Learning and students of class VII G (N = 31) which is a control class using conventional learning. The data collection technique used is a test for environmental literacy. Based on the results of the analysis from the Independent T-Test through the results of the environmental literacy posttest, which is 0.011. The results of the research that has been conducted show that the environmental literacy ability of students, especially in the experimental class on the knowledge indicator, has an N-Gain result of 0.55 in the medium category, cognitive ability has an N-Gain result of 0.49 in the medium category, students' attitude towards the environment has an N-Gain of 0.21 in the low category, and students' behavior towards the N-Gain environment 0.08 with the low category. This study can be concluded that the application of PBL has an influence on improving students' environmental literacy.

Keywords: *Problem Based Learning, Environmental Literacy, Ecology and Biodiversity*

Utilization of Waste Cooking Oil and Kasturi Lime (Citrus Microcarpa) Peel in Entrepreneurial Pedagogical Chemistry Knowledge (EPChK) Based Learning

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ABSTRACT

Entrepreneurial Pedagogical Chemistry Knowledge (EPChK) based learning is a learning that integrates three skills, namely Pedagogical Knowledge, Chemistry Knowledge and Entrepreneurial Knowledge with five stages, that is Analysis, Design, Production, Marketing and Evaluation. The output of this learning produces products of economic value, one of which is aromatherapy candles using waste cooking oil and kasturi lime peel. The stages include cleaning the waste cooking oil, macerating the kasturi lime peel, and making the aromatherapy candles. Data collection techniques were carried out by means of observation and product assessment. Product assessment is divided into three aspects, namely planning, process and evaluation. In the planning aspect, the criteria assessed are the utilization of natural materials as raw materials, innovation in product manufacturing, chemistry as the basis for product manufacturing, utilization of literacy and accuracy of product manufacturing design. In the aspect of the product manufacturing process, the criteria assessed are the tools and materials used, the steps taken and the process of making the product that is coherent and precise. In the evaluation aspect, the criteria assessed are the suitability of the product to the design, the usefulness of the product, attractive packaging and the selling value of the product. From the results of observations and product assessments, the aspect of student planning in preparing to make products with economic value is categorized as Very Good, the aspect of the process of making packaged serbat water is categorized as Very Good and the aspect of product production evaluation is categorized as Good.

Gender Representation in Senior High Chemistry Textbooks

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ABSTRACT

This study aims to compare the frequency of appearance of male and female representations in high school chemistry textbooks and analyze gender stereotypes in roles, professions, and activities presented in high school chemistry textbooks used in education in Indonesia. This type of research is a literature study/library analyzed using the content analysis method. The data sources used in this study are chemistry textbooks with three grade levels, namely grades X, XI, and XII at the Senior High (SMA). Data collection techniques in this study involve documentary methods or document reviews. The results of the analysis show that high school chemistry textbooks in Indonesia still show gender representation inequality, gender stereotypes are still strongly embedded significantly in the main dimensions: roles, professions, and activities. In the scientific field, women are more often depicted in supportive, domestic, or passive roles. While men are usually depicted in active, dominant, and professional roles. This inequality is reflected in illustrations, narratives, and depictions of professions and activities that reinforce social constructions of "natural" roles and abilities based on gender.

Developing MoleMaster: A Media-Based Learning Approach to Measure Students' Critical Thinking Skills"

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ABSTRACT

Critical thinking skills are one of the most important skills in the 21st century. This study aims to develop a digital learning media called MoleMaster to measure students' critical thinking skills. Using the 4D Research and Development (R&D) method, this study sfollows the stages of needs analysis, media design, expert validation, and limited testing. Data were collected through questionnaires, observations, and interviews, focusing on the critical thinking indicators proposed by Peter Facione. The results indicate that MoleMaster is effective in measuring students' critical thinking skills through structured content. Teachers and students are provided positive feedback on the media and recognized it as an innovative learning tool that supports the development of critical thinking. This study recommends the use of MoleMaster as an alternative medium to strengthen more reflective and critical learning processes.

Keywords: *MoleMaster, critical thinking skill, Research and Development, learning media*

STEM-RANDAI: A Novel Framework for Integrating Local Culture into Science Education to Enhance 21st-Century Skills

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ABSTRACT

Integrating cultural values, technology, and problem-solving exercises in the learning process is a supporting factor in developing students' 21st-century skills but is currently not widely applied in education. This is due to the limited learning guides in the form of learning models. This study aims to develop an initial design for a learning model that integrates cultural values, technology, and problem-solving. The model is called the STEM-RANDAI Model in biology learning. The development of this learning Model uses the Research and Development (R&D) method with the Plom Model. This study begins with Preliminary research through needs analysis and identification of problems in the biology learning process. Furthermore, the design and preparation of learning syntax and learning tools are carried out in the prototyping phase. Next, a feasibility test was carried out: product validation by experts and product trials in the learning process. Based on the results of the validation of biology learning strategy experts and small group trials, overall, the development of the STEM-RANDAI learning model is feasible with the criteria of "very valid" to be used as a step in biology learning to train students' 21st-century skills.

Integrating Ethnoscience into Project-Based Learning: Enhancing Creative Thinking and Learning Motivation on Reaction Rate Topic

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ABSTRACT

This study aimed to investigate the effect of an ethnoscience-based Project-Based Learning (PjBL) model on the creative thinking skills and learning motivation of students on the reaction rate topic. A quasi-experimental method was employed using a nonequivalent control group design. The sample consisted of two classes, an experimental group and a control group, with a total of 61 students. The instruments used were an essay test to measure creative thinking skills and a learning motivation questionnaire, both of which were found to be reliable, with Cronbach's Alpha values of 0.856 and 0.882, respectively. The data were collected using a series of pretests and posttests administered before and after the implementation of the ethnoscience-based PjBL model over six class meetings, including the project implementation stages. Data were analyzed using both descriptive and inferential statistics, including a normality test, homogeneity test, t-test, Pearson correlation, and N-Gain analysis. The findings indicated a significant effect of the ethnoscience-based PjBL model on students' creative thinking skills, as shown by the t-test results with a significance value of 0.003 ($p < 0.05$). Moreover, students' learning motivation also increased significantly, with a t-test significance value of 0.001 ($p < 0.05$). Thus, it can be concluded that the ethnoscience-based PjBL model positively impacted students' creative thinking skills and learning motivation on the reaction rate topic.

The Role of ChatGPT in Promoting Mathematical Critical Thinking Skills: A Factor Study

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ABSTRACT

The use of ChatGPT in mathematics learning provides various benefits, such as helping students understand complex concepts, obtain information quickly, and solve problems independently. ChatGPT functions as an interactive and responsive learning tool. However, the information generated is not always accurate and may contain calculation and logical errors. This condition requires students to have mathematical critical thinking skills to respond to information analytically and reflectively. This study aims to identify the structure of mathematical critical thinking skills in students' use of ChatGPT. The method used is quantitative-exploratory with the exploratory factor analysis (EFA) technique. The research instrument is a 4-point Likert scale questionnaire consisting of 15 items. The research sample consisted of 283 active students from the Mathematics Department, FMIPA UNP, from the 2021–2024 cohort, majoring in Mathematics and Mathematics Education, selected through purposive sampling based on the criterion of having used ChatGPT. Data analysis was conducted using SPSS version 30. The EFA results revealed four dominant factors, namely: (1) Critical Evaluation and Verification of Information, (2) Understanding and Conceptual Elaboration through ChatGPT, (3) Self-Correction and Metacognitive Awareness, and (4) Synthesis and Reconstruction of Mathematical Information, with a total variance of 61.049%, indicating that the four factors were able to explain most of the variance in the overall items. These findings suggest that mathematical critical thinking skills using ChatGPT are a multidimensional construct. The theoretical implications of these results strengthen the conceptual framework of critical thinking in the context of AI-based learning. In contrast, the practical implications include developing measurement instruments and designing mathematics learning strategies that can foster students' critical thinking skills in utilizing artificial intelligence technology.

Keywords: *Artificial Intelligence (AI); ChatGPT; Exploratory Factor Analysis (EFA); Mathematical Critical Thinking Skills; Mathematics Learning.*

SCIENCE E-COMIC ASSISTED BY APP-PIXTON GEOMETRIC OPTICS MATERIAL USING THE PBL MODEL

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ABSTRACT

This article discusses the development of e-comics using the Pixton application as a learning tool for geometric optics material using the Problem-Based Learning (PBL) model. Problem-based learning has been proven effective in improving students' conceptual understanding and critical thinking skills. In this context, e-comics designed with the Pixton application provide an innovative approach to delivering complex material in an engaging and interactive way. This study aims to explore the effectiveness of using e-comics in improving students' understanding of basic geometric optics concepts, as well as analyzing their impact on students' learning motivation. Through quantitative and qualitative methods, data was collected from surveys and interviews involving students who used e-comics in their learning. The results of the study indicate that the use of Pixton-assisted e-comics can enhance students' understanding and increase their interest and motivation in learning geometric optics material.

Enhancing Critical Thinking Skills Through STEM-Based Guided Inquiry on Reaction Rate Topics

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ABSTRACT

This study aimed to analyze the effect of implementing a STEM-based guided inquiry learning model on students' critical thinking skills regarding reaction rates. The study used a quasi-experimental method using a non-equivalent control group design. The sample consisted of sixty students from SMA Negeri 1 Bolaang-Uki, selected through purposive sampling. The instrument consisted of a set of ten essay questions that satisfied the reliability criteria, with a Cronbach's Alpha value of 0.706, categorized as high. The findings indicated that the implementation of the STEM-based guided inquiry learning model significantly improved students' critical thinking skills. This was evident from the average pretest score of 10.68%, which increased to 31.40% in the posttest. Hypothesis testing using the Independent-Sample t-test yielded a significance value of $0.000 < 0.05$, with $t_{(count)} > t_{(table)}$ ($29.709 > 1.671$). Therefore, the STEM-based guided inquiry learning model had a significant effect on improving students' critical thinking skills regarding reaction rates.

Keywords: *Guided Inquiry, STEM, Critical Thinking, Reaction Rate.*

The Effect of Implementation the Discovery Learning Model Assisted By Google Sites Learning Media on the Critical Thinking Ability of Grade VII Junior High School Students in the Material of Interaction Between Components of an Ecosystem

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ABSTRACT

The purpose of this study was to analyze the impact of the implementation of the Discovery Learning model supported by Google Sites learning media on the critical thinking skills of grade VII junior high school students on the material of interactions between components of the ecosystem. The method used is Quasi-Experimental research type Nonequivalent Control Group Design through Pretest-Posttest. This study involved two randomly selected classes, where the experimental class implemented the Discovery Learning model assisted by Google Sites media, while the control class implemented the conventional model. The instrument used to assess critical thinking skills was a validated essay test. The results showed a significant difference in students' critical thinking skills in both classes. Supported by the N-Gain of the experimental class of 56.64% which is greater than the control class which is only 34.44%, meaning that the model used is quite effective in improving critical thinking skills. These findings prove that the implementation of the Discovery Learning model assisted by Google Sites has a positive effect on improving students' critical thinking skills.

Exploring the Chemistry Mindset and Identity of Pre-Service Chemistry Teachers

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ABSTRACT

This study aims to describe the chemistry mindset and chemistry identity profiles of chemistry education students and analyse the relationship between the two. The study involved 42 chemistry education students at a private university in Indonesia. The study revealed that most students had a moderate to high chemistry mindset, with an average score of 3.72 on a scale of 5. Meanwhile, students' chemistry identity was also moderate, with an average score of 3.55. A significant positive relationship was observed between chemistry mindset and chemistry identity ($r = 0.63$; $p < 0.01$), indicating that students with a positive mindset towards chemistry tend to possess a stronger chemical scientific identity. The profiles of students' chemistry mindset and chemistry identity displayed a positive trend, although there remains room for further development. The significant relationship between the two highlights the importance of educational interventions that can strengthen both aspects simultaneously within the chemistry education curriculum.

ACADEMIC RESILIENCE OF HIGH SCHOOL STUDENTS WITH MOTIVATION TO LEARN CHEMISTRY AND CONCEPT UNDERSTANDING OF THE PERIODIC SYSTEM OF ELEMENTS

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ABSTRACT

The background of this research stems from the fact that students' understanding of the periodic table material remains inadequate, and their motivation to learn chemistry is relatively moderate (73.1% of students). In contrast, this material plays a crucial role as a foundation for subsequent chemistry learning. The purpose of the research was to examine the relationship between academic resilience, motivation to learn chemistry, and students' understanding of the periodic table concept in high school students in one of the districts in Pasuruan. The number of respondents involved was 227 students who were selected through stratified random sampling techniques, consisting of 140 tenth-grade students and 87 eleventh-grade students. The instruments used included an academic resilience questionnaire and a chemistry learning motivation questionnaire. The understanding of the periodic table concepts was measured through multiple-choice tests. The distribution of students' ability levels and response consistency was analyzed using the Rasch model. The classical assumption test indicated that the data did not meet the assumptions of normality and linearity, so the relationship between variables was analyzed using the non-parametric Spearman correlation test. Based on the data analysis results, most students were in the medium category for academic resilience (49.4%), chemistry learning motivation (48.3%), and understanding of the periodic table concepts (75.3%). In addition, the results of correlation analysis showed a very strong and significant relationship between academic resilience and chemistry learning motivation ($r = 0.974$; p-value < 0.05), academic resilience with understanding of the periodic table concepts ($r = 0.850$; p-value < 0.05), and chemistry learning motivation with an understanding of the periodic table concepts ($r = 0.844$, p-value < 0.05). Therefore, all null hypotheses (Ho) are rejected, and all alternative hypotheses (Ha) are accepted. These findings indicate that the higher the students' academic resilience, the greater their motivation to learn chemistry, which positively impacts their understanding of the periodic table concepts. This study emphasizes the importance of the role of academic resilience and learning motivation in supporting the success of chemistry learning in secondary school. Therefore, teachers should design learning strategies that not only focus on the cognitive aspect but also strengthen academic resilience and foster students' learning motivation to improve their understanding of the periodic table concepts in line with the expected learning outcomes.

Keywords: *Motivation, Periodic System, Resilience*

Gender and Science Teacher from a Student Perspective

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ABSTRACT

The gender of a teacher has the potential to influence the learning process, particularly in terms of teaching style, interaction patterns with students, and the emotional relationships established in the classroom. Therefore, students' perspectives on the gender of their science teachers may also affect their comfort in interacting and participating in the learning process. The objectives of this study are: (1) to explore students' perspectives on the gender of science teachers, and (2) to identify students' preferences regarding the gender of their science teachers. This research employs a survey method with a cross-sectional design. Data collection was conducted using a questionnaire distributed via Google Forms. The indicators measured in this study include students' perceptions, interests, and motivation toward the gender of their science teachers. A total of 262 students participated as respondents. The data were analyzed using quantitative descriptive techniques, presented through graphs, and interpreted to draw conclusions. The results of this study show that: 1) Female science teachers received more positive perspectives from the majority of students compared to male science teachers. 2) Students tend to feel more comfortable learning with female science teachers than with male science teachers. The findings of this study are expected to provide insights for teachers, schools, and prospective educators in understanding how students perceive gender roles in science education. Additionally, it may assist in adapting teaching strategies to create a more inclusive, effective, and comfortable learning environment for all students.

Synthesis and Characterization of HAp/Fe$_3$O$_4$ Nanocomposite from Chicken Bone Waste as an Environmentally Friendly Heterogeneous Catalyst Supporting Sustainable Energy

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ABSTRACT

The urgent need for sustainable energy demands innovation based on local resources and organic waste. Chicken bone waste, which is abundant in household trash, has shown great potential as a raw material for functional materials. This study aims to synthesize and characterize hydroxyapatite/magnetite (HAp/Fe$_3$O$_4$) nanocomposites from chicken bone waste as environmentally friendly heterogeneous catalysts. The synthesis was carried out using calcination and co-precipitation methods with temperature variations to obtain optimal catalytic performance. The calcination process produced CaO powder with the best yield of 71.12% at 800°C. Characterization was conducted using XRD, SEM-EDX, and FTIR instruments. The results showed that the HAp/Fe$_3$O$_4$ nanocomposite has a hexagonal close-packed and cubic crystal structure with a crystallite size of 20.14 nm. These findings indicate that the resulting nanocomposite has promising potential as a green heterogeneous catalyst in the synthesis of spirooxindole-chromene derivatives. This suggests that chicken bone waste can be a novel alternative for developing environmentally friendly technologies and sustainable energy solutions.

Keywords: *Chicken bone waste, HAp/Fe$_3$O$_4$, heterogeneous catalyst, environmentally friendly, sustainable energy*

Synthesis, Characterization, and Preliminary Study of [Cu(3-NH$_2$py)$_2$(Bz)$_2$] as an Antibacterial Agent

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ABSTRACT

The study of complexs compounds as antibacterial agents continues to advance in response to solve the problem of bacterial resistance to conventional antibiotics. Complex compounds with 3-NH$_2$py ligands have good antibacterial activity, but still lower than reference antibiotics. The selection of Cu^{2+} as the central ion and benzoate as anionic ligand is expected to enhance the antibacterial performance of 3-NH$_2$py based complexes. [Cu(NH$_2$py)$_2$(Bz)$_2$] complex was synthesized using an acetonitrile:water solvent system, reacted at room temperature for 4 hours. The resulting compound formed dark blue crystals with a melting point of 203–205 °C and exhibited molecular properties. FTIR characterization revealed shifts in the wavenumbers of ν(C=N*ring*), ring breathing, ν_{as}(COO$^-$), and ν_s(COO$^-$), indicating coordination of these functional groups to the Cu^{2+} ion. The UV-Vis spectrum shows three types of transitions. Complex compounds was adopts a pseudo-octahedral geometry and crystallizes in triclinic crystal system with $P\bar{1}$ space group. The strongest intermolecular interaction in this compound is hydrogen bond (N–H···O). Complex demonstrated inhibitory activity against *S. aureus* and *E. coli*, with inhibition zones larger than its precursor salt, ligand, and the reference antibiotic (chloramphenicol). These findings suggest combining 3-NH$_2$py, sodium benzoate, and Cu^{2+} successfully produces a coordination complex with enhanced antibacterial activity.

Effectiveness of Peer-Assessment in Problem-Based Learning in Improving Students' Science Process Skills on the Topic of Light Waves

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ABSTRACT

This study aims to examine the effectiveness of peer-assessment on problem-based learning in improving students' science process skills in high school on the topic of light waves. This research includes quantitative research with an experimental research type quasi-experimental design. The population is all students of class XI MIPA in one of the private high schools in Malang Regency using a nonequivalent control group design. The sample of the study amounted to 38 students, consisting of 19 experimental class students and 19 control class students selected using a cluster sampling technique. In the research that has been conducted, the peer-assessment learning model on problem-based learning is less effective in improving students' science process skills. This is indicated by the results of data analysis using IBM SPSS 25 obtained that the results of the Wilcoxon test showed a significant difference in science process skills between the experimental class and the control class of 0.008 ($p_{value} \leq 0,05$) for the control class and 0.000 ($p_{value} \leq 0,05$) for the experimental class, and the results of the N-Gain test analysis showed a value of 44.1% in the experimental class and 27.1% in the control class. In general, the average value of the indicators of students' science process skills on the topic of light waves in the experimental class pretest was 5.01. After being given peer-assessment on problem-based learning, the average posttest value increased to 10.65, showing an increase in science process skills on the discussion of waves, amounting to 5.64. The average KPS score obtained by students in the experimental class from the teacher was lower than the KPS score obtained from the teacher observer. The teacher's assessment received an average value of 75, while the KPS value from peer assessment received a value of 89.56.

The Effect of Differentiated e-LKPD Accompanied by Formative Feedback on Concept Understanding In Dynamic Fluid

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ABSTRACT

Dynamic fluid is one of the physics learning topics that requires a strong conceptual understanding. Currently, there are still many students who have difficulty understanding the concept of the material. This study aims to determine the effect of using differentiated e-LKPD accompanied by formative feedback on concept understanding in dynamic fluid material. This study used a pretest-posttest control group design. The sampling technique used was cluster random sampling with a sample of two classes, namely X1 MIPA students in one of the high-level schools. From the results of this study, it was found that there was an effect of using differentiated e-LKPD accompanied by formative feedback on students' concept understanding. The Wilcoxon test found that $p \leq 0.05$, with a result of 0.000, indicating that there was a significant difference in pretest and posttest results between the experimental and control classes on concept understanding. The effectiveness of learning between the two classes is differentiated based on the N-gain value at the median, where the experimental class reaches the N-gain score criteria "high" because the N-gain result is 0.75, and the control class reaches the N-gain score criteria "medium" because the N-gain result is 0.50. It can be concluded that there is a significant difference between the experimental class and the control class on concept understanding. Based on the results obtained, it can be stated that the provision of treatment in the form of differentiated e-LKPD accompanied by formative feedback has a positive impact on students' concept understanding in physics learning, especially on dynamic fluid material.

Keywords: *e-LKPD Differentiated, formative feedback, concept understanding*, *Physics Education*

DEVELOPMENT OF AN ELECTRONIC PORTFOLIO ASSESSMENT INSTRUMENT TO IMPROVE STUDENTS' HABITS OF MIND ON EXOTHERMIC AND ENDOTHERMIC REACTIONS

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ABSTRACT

The aims of the study is to obtain a valid and reliable electronic portfolio assessment instrument to improve students' habits of mind on exothermic and endothermic reaction materials. The research method used is Research and Development (R&D) with three stages of development models including design, define, develop. The participants in this study involved four chemistry education lecturers and three chemistry teachers as validators, twenty eleventh grade students at one of the Islamic Senior High School in West Java as research subjects. The electronic portfolio assessment instrument developed in the form of three types of tasks (summary, practicum simulation report, poster) and assessment rubrics are based on a combination of competency achievement indicators on exothermic and endothermic reaction materials with habits of mind indicators. The results showed that the electronic portfolio assessment instrument developed had good quality with a CVR value of 1.00 and a Cronbach Alpha value of 0.94-1,00. The results showed that electronic portfolio assessment instrument with the provision of feedback can improve students' habits of mind based on the N-Gain value of 0.7 with a medium category. In the trial task 1, 2, 3, the N-Gain value was 0,66 (medium); 0,74 (high); 0,71 (high). In the aspects of self-regulation, critical thinking, creative thinking, the N-Gain value was 0.73 (high); 0.66 (medium); and 0.64 (medium).

Keywords*: Electronic Portfolio Assessment, Habits of Mind, Exothermic and Endothermic Reaction*

Fun Collaborative-Project Based Learning for Gen Z

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ABSTRACT

Gen Z has unique characteristics, including very engaged in fast communication, particularly through digital platforms. In addition, Gen Z tends to have less interpersonal skills, empathy, and focus compared to previous generations. The goal of the partnership with industry is to foster Gen Z's collaboration skills needed by companies in the 21st century. Collaboration can be promoted through fun Project-based Learning involving multiple stakeholders. This learning is supported by various audiences, namely KDSI Partners (Learning Media Industry), Conservation Institution Managers, Junior High School Science Teachers, and Education for Sustainable Development Experts. The stages of Project-Based Learning are enhanced by optimizing process management. The designed learning activities supported students' collaboration skills by achieving indicators of effective communication, teamwork and interpersonal interaction, collaborative problem solving, responsibility and accountability, and flexibility and adaptability.

SYNTHESIS AND CHARACTERIZATION OF HAp-MgPO4 NANOCOMPOSITES FOR OPTIMIZATION OF GREEN MUSSELS WASTE AS ADSOR

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ABSTRACT

This study successfully synthesized HAp/Fe_3O_4 nanocomposites from chicken bones and their potential as heterogeneous catalysts. The main objective of this study was to determine the characterization of HAp/Fe_3O_4 nanocomposites from chicken bones. The synthesis process was carried out using calcination and coprecipitation with variations in calcination temperature to obtain catalysts with optimal characteristics. Material characterization was carried out using XRD, SEM-EDX, FTIR instruments. The analysis results showed that HAp/Fe_3O_4 has a hexagonal close-packed and cubic crystal structure with a crystallite size of 20.14 nm. HAp/Fe_3O_4 was confirmed to have varying plate morphology, so it can provide various crystallite sizes that are used as heterogeneous catalyst applications using chicken bones. The SEM-EDX characterization was confirmed with an average particle size of 500 nm. The functional groups PO_4^{3-}, OH^-, octahedral Fe–O, and tetrahedral Fe–O were detected at wave numbers 1082.07 cm-1, 3261.63 cm-1, 947.05 cm-1, and 1394.05 cm-1, respectively.

Keywords: *HAp/Fe_3O_4, heterogeneous catalyst, and chicken bones.*

Analysis of School Readiness in Implementing Chemistry Learning for Students with Disabilities: A Case Study at SMA Negeri 8 Surabaya

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ABSTRACT

This study aims to analyze the readiness of SMA Negeri 8 Surabaya in implementing chemistry instruction for students with disabilities, focusing on the curriculum, teaching staff, and infrastructure. This is a descriptive case study design. Data were obtained through in-depth interviews with the principal, chemistry teachers, and peers. The results indicate that the school's readiness is not yet optimal. From a curriculum perspective, the school does not yet have a modified curriculum specifically for students with disabilities, although teachers have made adjustments to teaching and evaluation methods. In terms of teaching staff, the school does not yet have a dedicated assistant teacher, although it has provided training for regular teachers. Facilities and infrastructure are also limited, particularly laboratories, which are not fully accessible to students with physical disabilities. However, the school strives to create an inclusive educational environment through mentoring, positive interactions between students, and collaboration with universities for teacher training. This study concludes that government support in the form of budgeting, expert staff, and more comprehensive policies are needed to improve the quality of inclusive education, particularly in chemistry instruction for students with disabilities.

SYNTHESIS AND CHARACTERIZATION OF HYDROXIAPATITE/Fe₃O₄ NANOCOMPOSITE FROM BAMBOO SHELL AS HETEROGENEOUS CATALYST IN SYNTHESIS OF SPIROOXINDOLE-CHROMENE DERIVATIVE COMPOUND

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ABSTRACT

Hydroxyapatite (HAp) has the chemical formula $Ca_{10}(PO_4)_6(OH)_2$ is an apatite mineral that is usually used as bone or dental implant. Hydroxyapatite can be used in various sectors, such as the environmental, health, to the renewable energy sector which is widely developed as a catalyst. Hydroxyapatite used in solution form often undergoes a suspension process, if in the form of nanoparticles, and is difficult to separate from the solution, thus reducing the effectiveness of the heterogeneous catalyst performance of HAp/Fe_3O_4 nanocomposites. The purpose of this study was to synthesize and characterize HAp/Fe_3O_4 nanocomposites from bamboo shell and to study their catalytic activity in the synthesis of spirooxindole-chromene derivative compound. The research method used the calcination method, both the synthesis of hydroxyapatite material, magnetite, and the combination of both syntheses into a composite. Primary data were obtained through research results in the form of quantitative data from characterization using XRD, XRF, VSM, LC-MS, SEM-EDX, AAS, and FTIR instruments. The calcination process produced CaO powder at a temperature of $800^{\circ}C$ producing a yield of 71.12%, a temperature of $900^{\circ}C$ producing a yield of 58.94%, and a temperature of $1000^{\circ}C$ producing a yield of 56.54%. The expected results of the HAp/Fe_3O_4 composite material as an environmentally friendly catalyst for spirooxindole-chromene derivative compounds by maximizing the potential of bamboo shells to extract calcium oxide (CaO) compounds and obtain % yield of 2-amino-7-hydroxy-2-oxo-spiro[chromene-4,3-indoline]-3-carbonitrile $(C_{20}H_{11}N_3O_4)$ experienced an increase in catalyst performance. Concluded the potential of bamboo shells is able to produce hydroxyapatite compounds with a comparison of magnetite material (Fe3O4) to be used as a spirooxindole-chromene catalyst.

Keywords: *Chicken bone waste, HAp/Fe₃O₄, heterogeneous catalyst, environmentally friendly, sustainable energy*

Improving Scientific Literacy Skills of Undergraduate Students through Case-Based Learning on Household Chemistry Course

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ABSTRACT

Scientific literacy is a fundamental competence for undergraduate students, particularly in courses that connect chemistry with daily life contexts. The household chemistry course provides opportunities for students to develop these skills through case-based learning, which encourages problem-solving and critical thinking. This study aimed to investigate the effectiveness of case-based learning in improving students' scientific literacy skills on the topic of sweeteners. A pretest–posttest design was used, involving undergraduate students enrolled in the household chemistry course. Students completed a scientific literacy test before and after the implementation of case-based learning. The results showed that the average pretest score was 81.25, while the posttest score increased slightly to 83.57, reflecting a modest gain of 2.32 points. Although the increase in the average score was minor, the standard deviation decreased from 10.46 to 8.52, indicating more consistent student performance in the posttest. These findings suggest that while case-based learning did not significantly increase the average scientific literacy score, it contributed to stabilizing students' performance and narrowing the gap between high and low achieving students. In conclusion, case-based learning remains a valuable approach in the household chemistry course, particularly in fostering equitable scientific literacy among students.

GreatChem: Disability-Friendly Augmented Reality Gamification Media for Teaching Reaction Rates using Green Chemistry Approach

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ABSTRACT

Inclusive education is one of the key components in realizing the fourth goal of the Sustainable Development Goals (SDGs), namely quality education.This is reinforced by Permendikbudristek Number 48 of 2023 which contains students with disabilities have the same rights in obtaining education. The guarantee of the right to education for students with disabilities is also supported by UN Convention Article 24 "Convention on the Rights of Persons with Disabilities" (CRPD). In Malang, inclusive schools strive to provide quality education to students with disabilities, one of which is deaf, but in its implementation it still faces various challenges, including the lack of interactive and innovative chemistry learning materials. This research is to hone the 21st century skills of students with disabilities, with a focus on collaboration and communication skills. Through the development of disability-friendly learning media, it is expected to be able to overcome this problem. The method used in this research is the R&D (Research and Development) method with the ADDIE model. This method is used to produce certain products and test the use of innovative learning media applications that are disability-friendly. Through GREATCHEM as a gamification media innovation of reaction rate with green chemistry insights integrated with disability-friendly augmented reality through 21st century skills, it is hoped that students with disabilities can gain skills and knowledge that are equal to other students, and can actively contribute to society. This initiative not only supports the SDGs, but also opens up new opportunities for the development of more inclusive and sustainable education in Indonesia. Thus, Malang's inclusive school can be a pioneer in the application of innovative chemistry learning methods.

Keywords: *Disability, Greatchem, Green Chemistry, 21st Century Skill, Reaction Rate*

Enhancing Scientific Literacy through an Interactive E-Module Enriched with Acehnese Local Wisdom

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ABSTRACT

This study aims to analyze the characteristics and assess the feasibility of an interactive e-module integrated with Acehnese local wisdom to enhance students' scientific literacy, specifically on the topic of sound waves. The research employed a Research and Development (R&D) approach using the ADDIE model, which consists of the stages: Analysis, Design, Development, and Implementation. Respondents involved in this study included both content and media experts as well as target users (students). The instrument validity and reliability were analyzed using expert validation and statistical reliability tests. The validation results indicated a high level of feasibility, with an average score of 86.5 (categorized as very feasible). Reliability analysis using Cronbach's Alpha yielded a coefficient of 0.815, indicating good reliability. Furthermore, the N-Gain score of 0.40 (40%) placed the learning gain in the medium category, demonstrating a moderate improvement in scientific literacy after the use of the developed e-module. The novelty of this research lies in the integration of Acehnese local cultural values into an interactive digital learning environment, which not only contextualizes abstract scientific concepts but also fosters cultural relevance in science education. Based on these findings, it can be concluded that the developed e-module is pedagogically sound, valid, and effective in improving scientific literacy. It is recommended that further research explore the implementation of local wisdom-based digital modules across other scientific domains and cultural contexts to support culturally responsive STEM education.

Pre-service chemistry teachers' misconceptions about the state of water changes associated with intermolecular forces

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ABSTRACT

Misconceptions can hinder the acquisition of chemical understanding in subsequent materials. Identifying misconceptions is the first step in overcoming them. Changes in matter are a basic concept in chemistry. The purpose of this study was to identify misconceptions about changes in matter, especially changes in the state of water, which are related to the basic concept of intermolecular forces. The subjects of the study were 60 students enrolled in the School Chemistry Teaching Materials Study Course. A two-tier diagnostic test was used as an instrument with 17 question items. All question items that had been developed were assessed by two expert validators in chemistry education, yielding a Content Validity Index (CVI) of 1. The reliability of the instrument, based on Inter-rater Agreement (IRA), yielded a score of 100. Therefore, 17 questions can be declared valid and reliable. The results showed that a total of 14 prevalent misconceptions (experienced by at least 20% of students) were detected. The most common misconception experienced by 48% of students was about the size of water molecules in different states. Many pre-service chemistry teachers assume that the size of water molecules varies from solid to liquid to gas due to the intermolecular forces in water. This misconception about phase changes of water is closely related to the concept of intermolecular forces. Learning about phase changes needs to be linked to interparticle forces.

Keywords: *Chemical misconceptions, interparticle forces, phase changes*

Exploring Science Teachers' Anxiety Levels: An Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) Approach to Instrument Validation

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ABSTRACT

Teachers play an important role in enhancing students' cognitive and practical competencies. However, conditions such as excessive workloads, difficulties in comprehending subject matter, and other external factors can sometimes trigger anxiety in teachers, especially in the context of science subjects, which are often perceived as challenging. On the other hand, programs currently initiated by the government often focus on improving teachers' skills, and there are no studies specifically focused on teachers' mental health in teaching. This study aims to develop and analyze the instrument validity and reliability by conducting Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). This study has adapted instruments previously formulated by earlier scholars and has also revised certain statements in accordance with current condition in Indonesia. This study encompassed a sample of 1,016 science teachers in Indonesia. The findings from the EFA shows that all items within the instrument meet the fit criteria with a loading factor greater than 0.05. Moreover, the CFA result demonstrates satisfactory factor loading; however, the model fit is suboptimal, suggesting the need for future refinements prior to the use of the instrument in further studies.

Effectiveness of Disaster Mitigation-Oriented Digital Books on Students' Collaboration and Problem-Solving Skills

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ABSTRACT

Problem-solving skills and collaboration skills are still a challenge in science learning. One effort that can be made is to link lesson materials with phenomenal issues in everyday life, namely disasters. This study aims to determine the effectiveness of the learning resources developed on Collaboration and Problem-Solving Skills.

This experiment applies the Solomon Four-Group Design without pretest. The population consists of students from class VIII of two primary schools, SMP 32 Padang and SMP 23 Padang. Samples are defined purposively and comprise 119 students classified into four groups with different treatments. Student A1 is involved in problem-based learning using books and Worksheets on Excretion Systems for Disaster Mitigation, and Student B1 on Respiration Systems for Disaster Mitigation. Students A2 and B2 are guided by worksheets only for each theme. Collaboration and problem-solving abilities are measured using a triangulation approach, which includes formative observation, student self-assessment, and document analysis. The data analysis was statistically done using an independent sample t-test.

The result of the study reveals that students A1 and B1 collaboration abilities were significantly higher (72 and 71) than students A2 and B2 (65 and 59). The abilities associated with the three developed skills are working efficiently, being respectful, and having flexible compromise skills. The two most prominent problem-solving abilities are looking back for solutions proposed related to the excretion system and disaster in A 1 students (89.6) and understanding the problem related to the respiration system and disaster in B1 students (89.7)

Keywords: *Collaboration, Problem-Solving, Disaster Mitigation, Digital Book, Worksheet*

The Implementation of PyMOL as a Computational Chemistry Media in Chemical Molecular Structure Learning through 3D Visualization for Enhancing Student's Spatial Ability

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ABSTRACT

Molecular structure is a challenging topic for students because it is abstract and difficult to visualize. Students still struggle to understand submicroscopic concepts of chemical problems. Spatial ability is an important aspects required to deeply understand molecular structures. This study aims to improve students' spatial ability by applying the Inquiry-Based Learning model using PyMOL as a 3D visualization media in teaching molecular structures. The method used in this study is a quasi-experiment with a pretest-posttest control group design, involving two grade X classes at SMA Cahaya Rancamaya Islamic Boarding School, Bogor. The experimental class used PyMOL as a 3D visualization media, while the control class used Molymod kits. The results showed that students who learned using PyMOL experienced significant improvements in spatial ability. Students are able to visualize and analyze molecular structures in three dimensions. This study demonstrates that using technology-based 3D visualization media can make abstract concepts easier to understand and help students enhance spatial ability. PyMOL as a computational chemistry media proves to be an alternative for 21st century learning needs.

Improving Higher Order Thinking Skills (HOTS) through a Scientific Approach Oriented to the Independent Curriculum in Teaching Salt Hydrolysis in Grade XI Senior High School

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ABSTRACT

This study examines the effectiveness of a scientific approach aligned with Indonesia's Independent Curriculum (Kurikulum Merdeka) in enhancing students' higher-order thinking skills (HOTS) in the context of salt hydrolysis learning. Using a quasi-experimental pretest-posttest control group design, 71 grade XI students were involved—36 in the experimental group and 35 in the control group—during the 2023/2024 academic year. The experimental group received instruction using the scientific approach, which integrates observing, questioning, data collection, associating, and communicating, combined with student-centered and differentiated learning principles. The control group received conventional instruction, which consisted primarily of lectures and guided discussions. Salt hydrolysis was chosen due to its cognitive demands in analyzing chemical reactions and evaluating factors affecting solution pH. Results showed a significant improvement in HOTS in the experimental group compared to the control group ($p < 0.05$), with average post-test scores of 62.42 and 35.91, respectively. These findings support the integration of curriculum-oriented scientific approaches to foster critical and analytical thinking in chemistry education.

Keywords: *higher-order thinking skills (HOTS), scientific approach, independent curriculum (Kurikulum Merdeka), salt hydrolysis, chemistry education*

Ethno-STEM Based Temperature and Heat Teaching Materials to Improve Problem Solving Abilities and Love for the Motherland

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ABSTRACT

This research aims to develop ethno-STEM based physics teaching materials on Temperature and Heat to improve students' problem solving abilities and patriotism. The specific aim is to test the validity, effectiveness and practicality of the teaching material product. This research and development uses the ADDIE (Analyze, Design, Develop, Implement, Evaluate) model. Teaching materials were developed through the integration of the STEM (Science, Technology, Engineering, Mathematics) approach and elements of local Indonesian wisdom in the form of traditional houses. The trial was carried out at one of the Semarang City Public High Schools with a Quasi Experimental–Nonequivalent Control Group design in two classes, namely the experimental and control classes. The instruments used include an indicator-based problem solving test, the Robust Assessment Instrument for Student Problem Solving, a love of country attitude questionnaire, as well as validation sheets, readability, problem solving tests and a practicality scale. The validation results show that the teaching materials are very valid (average 82.87%). Readability is in the easy to understand category (75.4%). The effectiveness test showed a significant increase in problem solving abilities (N-Gain = 0.70, high category) and patriotism (N-Gain = 0.33, medium category) in the experimental class. Teaching materials were also rated as very practical by teachers (85.71%) and students (85.93%). Thus, this ethno-STEM teaching material is valid, effective and practical to use in physics learning.

Keywords: *Teaching Materials, Ethno-STEM, Problem solving abilities, Love for the Motherland.*

Needs Analysis for Developing a Cognitive Diagnostic Assessment Using the Q-Matrix Framework to Support Differentiated Physics Instruction in Senior High Schools

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ABSTRACT

Physics education in Indonesia faces significant challenges in developing students' conceptual understanding, particularly in optics which requires complex abstract reasoning and visualization skills. Traditional assessment approaches provide limited diagnostic information to support differentiated instruction. This study aimed to analyze stakeholder needs for developing a cognitive diagnostic assessment (CDA) using Q-matrix framework to support differentiated physics learning in optics. This mixed-methods sequential explanatory study involved 504 participants from 8 senior high schools in Aceh Province, Indonesia, including 17 physics teachers, 482 grade XI students, and 5 school principals. Qualitative data were collected through semi-structured interviews and focus group discussions, while quantitative data were gathered through structured surveys. Thematic analysis was used for qualitative data, and descriptive statistics for quantitative data. Eight main themes emerged: (1) transition from intuitive to systematic assessment, (2) large-scale personalization dilemma, (3) hierarchical complexity of optics learning, (4) technology as enabler, (5) sustainable support ecosystem, (6) learning modalities, (7) representational competency, and (8) institutional readiness. Key findings revealed that 88.2% of teachers routinely conduct diagnostic assessment but 76.5% rely on simple manual analysis. Students demonstrated sophisticated expectations for immediate feedback (89.0%) despite infrastructure constraints. Stakeholders converged on the need for a cognitive diagnostic system that can address specific representational competencies in optics learning through Q-matrix framework. The system must balance pragmatic sophistication with physics-contextualized assessment while being infrastructure-adaptive and demonstrably effective.

Keywords: *CDA, Q-matrix, differentiated learning, physics education, optics*

Chemistry Education Students' Perspectives on Lecturer Gender

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ABSTRACT

This study aims to find out the perspective of chemistry education students on the gender of lecturers. This study uses a quantitative descriptive approach with a survey method. The research population is all students of state universities with chemistry education study programs or chemistry schools in East Java Province. Sampling was done using convenience sampling techniques. Data was collected through a questionnaire containing statements about student perceptions, interests and motivation based on the gender of lecturers using a Likert scale of 1-5. This research instrument produced a coefficient value of 0.9 for the validity test of the Gregory matrix and the results of the reality test using *a percentage of agreement* of 90%. Data analysis uses descriptive statistics. The results of the study show that the gender of lecturers does not fully determine the perspective of chemistry education students on learning. Thus, the results of this study fill the research gap and increase academic discussions about the role of gender in the learning process.

STEM and Local Wisdom: Integrating Nature-Based Learning Into the Classroom

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ABSTRACT

This study investigates the integration of STEM (Science, Technology, Engineering, and Mathematics) education with local wisdom through nature-based learning in the science classroom to improve digital literacy. Digital literacy is one of the important competencies for science teachers as educators in learning in the 21st century. Unfortunately, not every teacher has good mastery so training is needed to improve digital literacy. The purpose of this service is to improve the digital literacy of elementary school science teachers in Semarang City through STEM with local wisdom in deep learning science learning. The training method used facilitation-based action learning. The results of the study showed that there was an increase in the digital literacy of science teachers in Semarang City after attending the training. The presentation of materials by resource persons and case study-based practical activities on science learning with an STEM-local wisdom and applying the principles of deep learning mindful, meaningful, and joyful are able to improve teachers' mastery of digital literacy. Participants also gave positive responses to the feasibility of the training materials and presentation. This means that the implementation of training to improve the digital literacy of science teachers with STEM-local wisdom and deep learning has been carried out very well.

Keywords: *Deep Learning, Digital Literacy, Local Wisdom, Science Teacher, STEM*

STEAM Approach in Teaching Chemistry for Prospective Chemistry Teachers

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ABSTRACT

STEAM learning equips prospective chemistry teachers with 21st-century skills such as critical thinking, collaboration, and creativity, which are essential for designing interactive and relevant learning experiences. This enables them to teach chemistry concepts in an integrated manner with other disciplines, preparing students for complex global challenges. This study aim to determine the learning stages that can enhance the ability of prospective chemistry teachers to understand and design STEAM learning. This study used a classroom action research method with three cycles. The research subjects were 40 prospective chemistry teacher students attending a STEAM learning lecture. Data were collected through content analysis of their worksheets, classroom observations using a rubric, and questionnaires to explore the learning paths and identify possible obstacles. The results showed that the STEAM learning stages, consisting of stage 1: STEAM theory, stage 2: STEAM project, and stage 3: STEAM learning design, were able to improve the ability of prospective chemistry teachers to understand and design chemistry learning with the STEAM approach. However, the exploration of contexts that can be used as cases and the experience of integrating STEAM into their learning design still require more intensive training.

Keywords: *STEAM, chemistry, prospective teacher, classroom action research, models of teaching*

Picture and Picture Pedagogy in Microbiology: Strengthening Student Understanding of Microorganism Reproduction and Visual Literacy Skills

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ABSTRACT

Understanding the reproduction of microorganisms poses conceptual and visual challenges for students due to the abstract nature and microscopic scale of the topic. This study aimed to evaluate the effectiveness of the Picture and Picture pedagogy in strengthening students' concept mastering and visual literacy in a microbiology course. A classroom-based intervention was conducted using a total sampling method involving 79 undergraduate students. Teaching was delivered in a single 100-minute session (2 credits), integrating the Picture and Picture method to explain microorganism reproduction. Student performance was measured using a pretest–posttest design conducted within the same meeting. The results revealed a normalized gain (N-gain) score of 0.61, indicating moderate to high learning improvement. The Wilcoxon Signed Ranks Test showed a significant difference in learning outcomes ($Z = -7.563$, $p < 0.001$). Additionally, Likert scale responses administered post-test demonstrated high levels of visual literacy: Visual Reconstruction scored highest at 76.53%, followed by Visual Association (76.00%), Visual Comparison (75.47%), and Visual Thinking (74.67%). These findings underscore the method's strong contribution to both cognitive achievement and visual skill development. In conclusion, visual-based pedagogies such as Picture and Picture can effectively enhance student understanding of abstract biological concepts while supporting the development of science communication competencies. It is recommended that science educators adopt this strategy to promote inclusive, multimodal learning experiences, especially in sustainability-oriented curricula.

Keywords: *concept mastering; microbial reproduction; picture and picture; science teaching method; visual literacy*

PROSPECTIVE TEACHER STUDENT'S MASTERY OF THE CONCEPTS OF FORCE, ACCELERATION, AND SPEED: THE CASE OF VERTICAL MOVING OBJECTS

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ABSTRACT

The study aims to determine the mastery of concepts of prospective teacher students related to force, acceleration, and speed, especially in vertical moving objects. This descriptive study involved 46 prospective physics teacher students. (add male and female students) The study used a test instrument consisting of 36 short answer questions and descriptions related to force, acceleration, and speed in 4 cases of a ball moving vertically in the air. In each case, students were also asked about the direction, magnitude, and arguments underlying their explanations. Data analysis was carried out using the Miles and Huberman technique. The results showed that prospective teacher students had a mastery of concepts in the fairly good category with an average score of 61.89. Prospective teacher students had a low mastery of concepts of 45.2% for the case of a ball when it is about to be thrown upwards and still touching the hand. Prospective teacher students also showed a good mastery of concepts in the case of a ball moving downwards with an average of 84.8%. It is important to provide various situations of object motion so that prospective teacher students have a good mastery of this concept.

Assessing Students' Graph Interpretation Ability Through the Use of Educational Research Statistics Learning Material

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ABSTRACT

Graph interpretation skills are essential for students, especially in understanding data derived from educational research. However, many students struggle to read and interpret graphs, particularly in the context of the Educational Research Statistics course. This study aims to analyze the improvement in students' graph interpretation abilities after using contextually and applicatively developed teaching materials for the course. The research employed a **quasi-experimental approach** with a **one-group pretest-posttest design**. The subjects were 17 students enrolled in the Educational Research Statistics course during the even semester of 2024/2025 at Universitas Negeri Semarang. The instrument used was a graph interpretation test administered before and after the intervention. Students' learning outcomes were also analyzed through their scores on assignments, quizzes, midterm, and final examinations. The results showed a significant improvement in students' graph interpretation skills, as indicated by increased average scores in assignments, quizzes, and final exams. Most students achieved final grades in the A category (scores ranging from 86–89), with high participation and attendance levels. The study concludes that the use of contextually designed teaching materials in the Educational Research Statistics course effectively enhances students' graph interpretation skills.

Keywords: *graph interpretation, teaching materials, educational research statistics, quasi-experimental*

USE OF REMOTE SENSING TO IDENTIFY WATER SOURCES IN BANGLI REGENCY, BALI

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ABSTRACT

Remote sensing can help identify potential water sources using Sentinel-2 imagery. This imagery produces slope gradients that are used to identify water sources. Satellite imagery is processed in QGIS software, which produces contours and slope gradients. On a land contour map, identification of potential water sources can be classified according to the location of the spring's appearance on a particular slope, namely a steep area. In addition to using contours, identification of potential water sources can also be done through slopes. The processed imagery, which creates contours and slopes, can help identify potential springs for the construction of wells for the surrounding community.

Keywords: *Remote Sensing, Springs, Slope Gradient*

Relationship Between Conceptual Understanding of Newton's Laws and Belief Attitude Towards Physics and Learning among Students Viewed From Gender and School Type Aspects

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ABSTRACT

The study aims to analyze students' level of understanding of Newton's laws and their Belief Attitude Towards Physics and Learning (BAPL) in terms of gender and school type, as well as to analyze the correlation between students' understanding of Newton's laws and their BAPL in physics learning. Students' understanding of Newton's laws and their BAPL in terms of gender and school type were analyzed using quantitative descriptive methods. This study used a survey method on students in the even semester of the 2024/2025 academic year. The research population consisted of all 11th-grade physics students in eight high schools in the cities of Malang and Batu. The sample consisted of 329 students, including 162 male students and 167 female students. Based on school type, the sample included 166 students from senior high schools and 163 students from Islamic senior high schools, while based on school status, the sample included 235 students from public schools and 94 students from private schools. The sample was determined using cluster random sampling. Data were analyzed using descriptive statistics, t-tests, and correlation tests using SPSS software. The results of the study indicate that students' understanding of Newton's Laws is still relatively low, both based on gender and school type. Students' BAPL results show moderate performance, with variations in results based on gender and school type. The correlation between understanding of Newton's Laws and students' BAPL results is classified as very low and statistically insignificant.

Spectrophotometric Analysis Based on Digital Color Images to Improve Conceptual Understanding and Critical Thinking Skills

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ABSTRACT

Learning innovations need to develop an understanding of concepts and critical thinking skills. This research aims to innovate learning by creating digital color image-based chemical analysis methods to overcome limited access to UV-Vis spectrophotometers. An experimental research design was applied to 130 students participating in the Chemistry Instrumental Analysis practicum course. Digital color image-based chemical analysis data were evaluated for validity and compared with analysis results using UV-Vis spectrophotometry. Concept understanding data was obtained through essay tests, and critical thinking skills data was obtained through an authentic assessment. The research results show that the two analysis methods were not significantly different. There is an increase in students' mastery of spectroscopy concepts and critical thinking abilities in the medium category. Students still need to develop the ability to connect concepts from experimental data to draw a conclusion. Digital color image-based chemical analysis methods can be an alternative in laboratory practicums.

Keywords: *Chemistry Instrumental Analysis course, smartphone-based digital color image, methods validation*

CONTRIBUTION OF MANGROVE TO BAJO COMMUNITY A CASE STUDY OF ENVIRONMENT LITERACY

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ABSTRACT

Mangrove forests are essential ecosystems that support the lives of coastal communities. However, in recent decades, mangrove forests have experienced significant pressure due to human activities, such as land conversion, illegal logging, and environmentally unfriendly coastal development. This study aims to describe the role of the Bajo people in managing mangroves through local wisdom practices as a form of environmental literacy. This research used a qualitative approach using in-depth interviews, participant observation, and documentation. The results indicate that the Bajo people have a high level of environmental literacy, reflected in ecological awareness, conservative practices, and the application of traditional values such as the parika tradition, the slash-and-plant system, and social sanctions for those who damage the environment. These findings emphasize the importance of strengthening local knowledge as an educational and ecological strategy to support sustainable coastal conservation.

Keywords: *local wisdom, Bajo people, mangroves, coastal communities*

PHOTOCATALYTIC DEGRADATION OF RHODAMIN B IN SIMULATION OF TEXTILE DYEING PROCESS WASTE WITH Fe$_3$O$_4$/SiO$_2$/CuO COMPOSITE

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ABSTRACT

One type of waste that pollutes the environment is liquid waste containing synthetic dyes, such as Rhodamine B. This dye is widely used in textile dyeing processes, but has a significant environmental impact. This study aims to synthesize Fe$_3$O$_4$/SiO$_2$/CuO to reduce Rhodamine B dye levels and test the performance of reusable adsorbents to reduce Rhodamine B levels in a textile dyeing process waste simulator. The photocatalytic adsorption method using magnetic composites is one of the treatment efforts to remove Rhodamine B dye from simulated textile dyeing waste. Magnetic-based adsorbents are combined with metal oxide catalysts to degrade the dye photocatalytically. The adsorbent used is a Fe$_3$O$_4$/SiO$_2$/CuO composite which can act as a magnetic adsorbent and a photocatalytic dye degrader. The Fe$_3$O$_4$/SiO$_2$/CuO composite showed the ability to reduce Rhodamine B levels in the Waste Simulator by 89.43% with an optimum mass of 0.75 g (adsorption capacity of 0.7154 mg RhB/g adsorbent). This adsorbent was reused in three cycles after the first use. The composite capacity decreased gradually with each reuse, with a decrease 10% in the second cycle and 17.5% in the third cycle, indicating a decrease in the effectiveness of the adsorbent.

Keywords: *Nanomagnetite, Silica, CuO, Rhodamine B, Waste Simulation.*

Schedule

SCHEDULE OF THE INTERNATIONAL CONFERENCE ON SCIENCE EDUCATION (ICoSE 2025)

in conjunction with the Asosiasi MIPA LPTK Indonesia (AMLI) meeting 2025

Thursday, 7 August 2025

Time	Programs	PIC
07.00 – 07.45	Registration	MC; Committee
07.45 – 08.00	Opening Ceremony by MC	MC; Committee
08.00 – 08.10	Indonesian National Anthem	MC; Committee
08.10 – 08.20	**Welcoming Speech** by Chairman of ICoSE 2025	Prof. Habiddin, S.Pd., M.Pd., M.Si., Ph.D.
08.20 – 09.00	**Keynote Speaker I** Asst Prof. Jina Chang, Nanyang Technological University, Singapore	Moderator: Erti Hamimi, S.Pd, M.Sc
09.00 – 09.40	**Keynote Speaker II** Prof. Maija Aksela, Helsinki University, Finland	Online video
09.40 – 10.20	**Keynote Speaker III** Dr.rer.nat. Safwatun Nida, Universitas Negeri Malang, Indonesia	Moderator: Erni Yulianti, S.Pd., M.Pd., Ph.D.
10.20 – 11.00	**Keynote Speaker IV** Assoc. Prof. Andrew Adewale Alola, Universitetet i Innlandet, Norway	Moderator: Indra Fardhani, S.Pd, M.Sc, M.I.L., Ph.D
11.00 - 13.00	Parallel session (Room 1-5)	Operator & Parallel Moderators

PARALLEL ROOM

ROOM 1

Moderator : **Imam Syamsuddin**
Operator : **Nurardiansyah Alif Putra Wijaya**

No	Time	Abstract ID	Author	Title
1	11.00 – 11.15	-	**Invited Speakers:** Dr. Oktavia Sulistina, S.Pd., M.Pd, Universitas Negeri Malang, Indonesia	STEAM Approach in Teaching Chemistry for Prospective Chemistry Teachers
2	11.15 – 11.25	141	KIRAN M (Velalar college of engineering and technology)	Stress Classification based onThermal Signature Analysis using AI-driven Models
3	11.25 – 11.35	144	Mochammad Yasir (Perkumpulan Pendidik IPA Indonesia (PPII))	Bridging Sustainable Science Education and Culture: The Role of Educational Augmented Reality Media in Ethnoscience and Cultural Literacy
4	11.35 – 11.45	145	Jessica Pasa (Universitas Mulawarman)	The Effectiveness of the Think Talk Write (TTW) Learning Model on Improving Students' Critical Thinking Skills in Chemical Bonding
5	11.45 – 11.55	147	Imam Samodra (Sebelas Maret University)	Driving Question Formulation in Green Chemistry: A Computational Thinking Approach
6	12.05 – 12.15	151	Oktariani oktariani (Universitas Pendidikan Indonesia)	Profile of Prospective Chemistry Teachers' Knowledge about Green Chemistry: A Cross-Institutional Survey
7	12.25 – 12.35	152	Khaula Noorul 'Ain (Universitas Pendidikan Indonesia)	Multivariate and Correlational Analysis of Students^ Dispositions and Creative Products through STEM-DT-Based Water Filtration Project Learning
8	12.35 – 12.45	154	Julia Astutik (Universitas Negeri Surabaya)	Improving Critical Thinking Skills of Junior High School Students through the Implementation of STEM-Based IPDBL Model on Additive Substances in the Context of Sustainable Education
9	12.45 – 12.55	159	Wiwin Hadi (Universitas Negeri Surabaya)	Cultural Context in Science Education: Improving Scientific Literacy through Batik Tanjung Bumi
10	12.55 – 13.05	211	Tafaul Magfirda (Universitas Negeri Malang)	Synthesis and Characterization of HAp/Fe_3O_4 Nanocomposite from Chicken Bone Waste as an Environmentally Friendly Heterogeneous Catalyst Supporting Sustainable Energy

PARALLEL ROOM

ROOM 2

Moderator : Khalis Nadhira S.
Operator : Muhammad Wildan Nashihin

No	Time	Abstract ID	Author	Title
1	11.00 – 11.15	-	**Invited Speakers:** Eva Ari Wahyuni, PhD, Universitas Trunojoyo Madura, Indonesia	Pesticides as risk factors for DNA damage: human liver cells
2	11.15 – 11.25	161	Safriza Hikmah (State University of Malang)	Characterization of HiMedia Commercial Papain Enzyme and Implications for STEM-based Sustainable Education
3	11.25 – 11.35	162	M. Amien Rais (Universitas Trunojoyo Madura)	Comparative Effectiveness of Lecture-Based and Presentation-Review Learning Methods in Enhancing Student Outcomes in Basic Biology Courses
4	11.35 – 11.45	164	Hunaepi Hunaepi (Universitas Pendidikan Mandalika)	Science Teachers' Perceptions of Integrating Sustainability Education into STEM-Based Deep Learning in Junior High Schools in West Nusa Tenggara
5	11.45 – 11.55	168	Safwatun Nida (Universitas Negeri Malang); Zahra Lintang Putri (Universitas Negeri Malang)	Implementation of PBL (Problem Based Learning) To Improve Students' Scientific Literacy On Nutritional Status Measurement Material
6	12.05 – 12.15	172	Rachma tunnisa (Universitas Negeri Malang)	Development Of Teaching Modules For Redox Concepts and Electrochemical Cells Using LC-5E With The Context Of Socio Scientific Issues and Sustainable Development Goals-Clean And Affordable Energy
7	12.25 – 12.35	175	Vina Serevina (Universitas Negeri Jakarta)	Application of Physics Learning Management in Classroom Action Research with STEM Integrated Motion Kinematics Material to Improve Literacy Skills
8	12.35 – 12.45	176	Vina Serevina (Universitas Negeri Jakarta)	Implementation of the Project Based Learning (PjBL) Model on Measurement Topic to Improve Student's Collaboration Skills
9	12.45 – 12.55	177	Eli Rohaeti (UNY)	Interactive Project-Based Learning Module in Cosmetic Chemistry: Enhancing Practical Skills and Self-Efficacy Among Pre-Service Chemistry Teachers
10	12.55 – 13.05	212	Saidatul Kholidia (Universitas Negeri Malang)	Synthesis, Characterization, and Preliminary Study of $[Cu(3-NH_2py)2(Bz)_2]$ as an Antibacterial Agent

PARALLEL ROOM

ROOM 3

Moderator : Fasha Juliandani
Operator : Surya Ady Pratama

No	Time	Abstract ID	Author	Title
1	11.00 – 11.10	178	A Halim (FKIP-USK)	An Analysis of the Relationship Between TPACK Understanding and Practical Experience in Misconception Remediation from the Perspective of Science Teachers' Gender
2	11.10 – 11.20	179	Yusnaeni Yusnaeni (Universitas Nusa Cendana)	Problem Solving Ability In Classroom With Asicc Learning Model
3	11.20 – 11.30	181	Muhammad Fajar Marsuki (Doctorate Program of Natural Science Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret)	Generative AI in Science Education: A Meta-Analysis of Its Effectiveness and Contextual Moderators
4	11.30 – 11.40	186	Dea Safitri (Universitas Negeri Malang)	Comparative study: Optimisation of portable reactor biogas production utilising cattle farm waste with the addition of EM4, tape yeast, and papain enzyme
5	11.40 – 11.50	187	Adelliana Niqris (University of Malang)	Implementation of Field Trip and Chemis-Tea (Chemistry in Tea) Interactive Media to Improve Students' Scientific Literacy Skills as a Form of Non-Formal Learning in Wonosari Tea Agrotourism
6	12.00 – 12.10	188	Amalia Rahmadani (Universitas Negeri Yogyakarta; Universitas Negeri Makassar)	A Systematic Review: Socio-Scientific Issue Writing Activity Through Problem Based Learning for Enhancing Students' Scientific Literacy on Covid-19 Topic
7	12.20 – 12.30	190	Tamrin Taher (Universitas Sebelas Maret)	Bridging Indigenous Knowledge and Environmental Literacy: A Bibliometric Analysis of Global Research Trends (2016-2025)
8	12.30 – 12.40	193	Devita Ramadhani and Habiddin Habiddin (Universitas Negeri Malang)	Development of Interactive E-Module to Improve Students Creative Thinking Skills in Mixture Materials
9	12.40 – 12.50	194	Sintya Aimatus Solikhah (Universitas Negeri Malang)	Students' Conceptions of Chemical Bonding: A Needs Assessment Study
10	12.50 – 13.00	196	Irbah Jihan Nabila dan Dian Nugraheni (Universitas Negeri Malang)	The Effect of Problem Based Learning (PBL) on Students' Environmental Literacy on Ecology and Biodiversity Materials
11	13.00 – 13.10	243	Nur Syahidah (Malang State University)	Photocatalytic Degradation of Rhodamin B in Simulation of Textile Dyeing Process Waste with $Fe_3O_4/SiO_2/CuO$ Composite

PARALLEL ROOM

ROOM 4

Moderator : Theresia Missyerum
Operator : Jovita Elok

No	Time	Abstract ID	Author	Title
1	11.00 – 11.10	197	Nurdianti Awaliyah (State University of Malang)	Utilization of Waste Cooking Oil and Kasturi Lime (Citrus Microcarpa) Peel in Entrepreneurial Pedagogical Chemistry Knowledge (EPChK) Based Learning
2	11.10 – 11.20	198	Fransiska Arnitadella (Universitas Negeri Malang)	Gender Representation in Senior High Chemistry Textbooks
3	11.20 – 11.30	201	Fatimah Az-Zahra (Universitas Negeri Malang)	Developing MoleMaster: A Media-Based Learning Approach to Measure Students' Critical Thinking Skills
4	11.30 – 11.40	203	Astin Lukum (Department of Chemistry, Universitas Negeri Gorontalo)	Integrating Ethnoscience into Project-Based Learning: Enhancing Creative Thinking and Learning Motivation on Reaction Rate Topic
5	11.40 – 11.50	206	Masrid Pikoli (Department of Chemistry, Universitas Negeri Gorontalo)	Enhancing Critical Thinking Skills Through STEM-Based Guided Inquiry on Reaction Rate Topics
6	12.00 – 12.10	207	Nana Saputri (Universitas Negeri Malang)	The Effect of Implementation the Discovery Learning Model Assisted by Google Sites Learning Media on The Critical Thinking Ability of Grade Vii Junior High School Students in The Material of Interaction Between Components of an Ecosystem
7	12.20 – 12.30	208	Elferida Sormin (Universitas Kristen Indonesia)	Exploring the Chemistry Mindset and Identity of Pre-Service Chemistry Teachers
8	12.30 – 12.40	210	Akmal Rizky Prasetya (Malang State University)	Gender and Science Teacher from a Student Perspective
9	12.40 – 12.50	216	Dian Nugraheni (Program Studi Pendidikan IPA FMIPA Universitas Negeri Malang)	Fun Collaborative-Project Based Learning for Gen Z
10	12.50 – 13.00	220	Ernita Aulia (Universitas Negeri Surabaya)	Improving Scientific Literacy Skills of Undergraduate Students through Case-Based Learning on Household Chemistry Course
11	13.00 – 13.10	209	Annisa Dzikrillah, Husni Wahyu Wijaya (Universitas Negeri Malang)	Academic Resilience of High School Students With Motivation to Learn Chemistry and Concept Understanding of the Periodic System of Elements

PARALLEL ROOM

ROOM 5

Moderator : Selvina Nur Afidya
Operator : Fatimah Az-Zahra

No	Time	Abstract ID	Author	Title
1	11.00 – 11.10	223	Sri Winarni (Program Studi Pendidikan Kimia FKIP Universitas Syiah Kuala)	Pre-service chemistry teachers' misconceptions about the state of water changes associated with intermolecular forces
2	11.10 – 11.20	224	Amaira Utami (Universitas Pendidikan Indonesia)	Exploring Science Teachers' Anxiety Levels: An Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) Approach to Instrument Validation
3	11.20 – 11.30	226	Muhamad Ramadhan (Universitas Pakuan)	The Implementation of PyMOL as a Computational Chemistry Media in Chemical Molecular Structure Learning through 3D Visualization for Enhancing Student's Spatial Ability
4	11.30 – 11.40	228	Amyza Rohim (Universitas Negeri Malang)	Improving Higher Order Thinking Skills (HOTS) through a Scientific Approach Oriented to the Independent Curriculum in Teaching Salt Hydrolysis in Grade XI Senior High School
5	11.40 – 11.50	232	Fitria Herliana (Universitas Syiah Kuala)	Needs Analysis for Developing a Cognitive Diagnostic Assessment Using the Q-Matrix Framework to Support Differentiated Physics Instruction in Senior High Schools
6	12.00 – 12.10	217	Alfi Fitriana (Universitas Negeri Malang)	Synthesis and Characterization of Hydroxiapatite/Fe_3O_4 Nanocomposites From Chicken Bones and Its Potential as A Heterogeneous Catalyst
7	12.20 – 12.30	237	Afifah Hani (Physic Education in Malang State University)	Prospective Teacher Student's Mastery of the Concepts of Force, Acceleration, and Speed: the Case of Vertical Moving Objects
8	12.30 – 12.40	239	Gede Yasada (PNB)	Use of Remote Sensing to Identify Water Sources in Bangli Regency, Bali
9	12.40 – 12.50	242	Maysara Maysara	Contribution of Mangrove to Bajo Community a Case Study of Environment Literacy
10	12.50 - 13.00	219	Dika Putra Wijaya	Synthesis and Characterization of Hydroxiapatite/Fe_3O_4 Nanocomposite from Bamboo Shell as Heterogeneous Catalyst in Synthesis of Spirooxindole-Chromene Derivative Compound
11	13.00 – 13.10	221	Ulfa Rahmawati (Universitas Negeri Malang)	GreatChem: Disability-Friendly Augmented Reality Gamification Media For Teaching Reaction Rates Using Green Chemistry Approach

AMLI Presenters

No	Abstract ID	Author	Title
1	157	Cholis Sa'dijah, Lathiful Anwar, Anita Dewi Utami (Universitas Negeri Malang)	Integration of Technological Pedagogical and Content Knowledge in the Mathematics Learning Assessment Course: Strategies to Encourage Critical Thinking and Prepare Prospective Teachers to Face 21st-Century Challenges
2	166	Alfidian Ningrum (Universitas Negeri Malang)	Development of LKPD based on Socio-Scientific Issues Using the "Penyu Kita" Application to Increase Students' Environmental Awareness, Attitudes, and Behavior
3	167	Indra Fardhani (Universitas Negeri Malang)	Bringing Plants into Focus: Enhancing Middle Schoolers' Plant Awareness through Cooperative Learning
4	173	Novi Dewi (Universitas Negeri Semarang)	Development and Validation of an ICT-Based TPACK Test for Pre-Service Science Teachers: Toward Objective and Scalable Assessment
5	174	Lathiful Anwar (Universits Negeri Malang)	Analysis of TPACK Components and Critical Thinking Indicators in Teaching Materials Developed by Prospective Mathematics Teachers
6	180	Salma Firdaus (Universitas Negeri Malang)	The integration of traditional values in sustainable chemistry education: An idea
7	182	Habiddin Habiddin (Universitas Negeri Malang)	Science Identity and Science Mindset: How They Predict Student' Critical Thinking in Additive and Addictive Substances
8	183	Harman Amir (Universitas Negeri Padang)	West Sumatra's Natural Potential for Studies in Education and Geophysical Sciences
9	185	Nur Faradillah (Universitas Negeri Malang)	Analysis of School Readiness in Implementing Chemistry Education for Students with Physical Disabilities in Senior High Schools in Malang City
10	191	Asrizal Asrizal (Universitas Negeri Padang)	Development of climate change on global warming e-module integrated PBL Model for independent curriculum learning
11	192	Finurika Rohmati (Universitas Negeri Malang)	High School Students' Perspektive on the Gender of Chemistry Teacher in Malang City
12	195	Eli Rohaeti (UNY)	Assessing Problem-Solving and Academic Writing Skills of Chemistry Students: A Preliminary Study for PLISTEAM-ViRal Model Development
13	202	Fitri Arsih (Universitas Negeri Padang)	STEM-RANDAI: A Novel Framework for Integrating Local Culture into Science Education to Enhance 21st-Century Skills
14	204	Suherman Akbar (UNP)	The Role of ChatGPT in Promoting Mathematical Critical Thinking Skills: A Factor Study
15	205	Febri Yanto (UNP)	Science E-Comic Assisted by App-Pixton Geometric Optics Material Using the PBL Model
16	213	Khusaini Khusaini (Jurusan Fisika FMIPA UM)	Effectiveness of Peer-Assessment in Problem Based Learning in Improving Students' Science Process Skills on the Topic of Light Waves
17	214	Khusaini Khusaini (Jurusan Fisika FMIPA UM)	The Effect of Differentiated e-LKPD Accompanied by Formative Feedback on Concept Understanding In Dynamic Fluid
18	215	Nahadi Nahadi (FPMIPA UPI)	Development of an Electronic Portfolio Assessment Instrument to Improve Students' Habits of Mind on Exothermic and Endothermic Reactions
19	218	Ilmi Ilmi (Universitas Negeri Malang)	Analysis of School Readiness in Implementing Chemistry Learning for Students with Disabilities: A Case Study at SMA Negeri 8 Surabaya
20	225	Muhyiatul Fadilah (Universitas Negeri Padang)	Effectiveness of Disaster Mitigation-Oriented Digital Books on Students' Collaboration and Problem-Solving Skills
21	229	Ani Rusilowati (Universitas Negeri Semarang)	Ethno-STEM Based Temperature and Heat Teaching Materials to Improve Problem Solving Abilities and Love for the Motherland
22	233	Iswatul Mukarromah (Universitas Negeri Malang)	Chemistry Education Students' Perspectives on Lecturer Gender

23	234	Arif Widiyatmoko (Universitas Negeri Semarang)	STEM and Local Wisdom: Integrating Nature-Based Learning Into the Classroom
24	236	Fidia Fibriana (Universitas Negeri Semarang)	Picture and Picture Pedagogy in Microbiology: Strengthening Student Understanding of Microorganism Reproduction and Visual Literacy Skills
25	238	Bambang Subali (FMIPA UNNES)	Assessing Students' Graph Interpretation Ability Through the Use of Educational Research Statistics Learning Material
26	240	Sentot Kusairi (Program Studi Pendidikan Fisika, FMIPA Universitas Negeri Malang)	Relationship Between Conceptual Understanding of Newton's Laws and Belief Attitude Towards Physics and Learning among Students Viewed From Gender and School Type Aspects
27	241	Agung Prasetya (Universitas Negeri Semarang)	Spectrophotometric Analysis Based on Digital Color Images to Improve Conceptual Understanding and Critical Thinking Skills