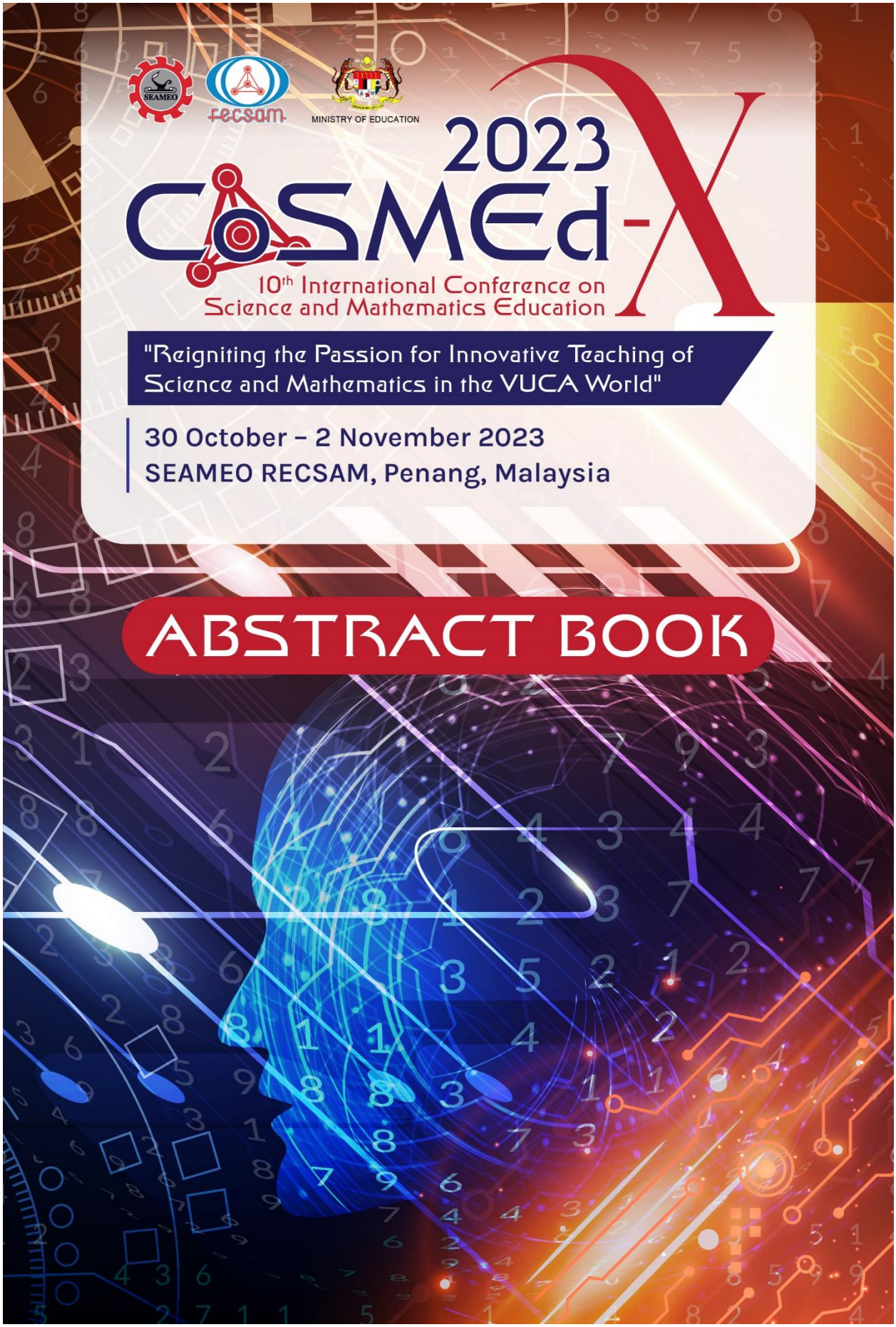
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ABSTRACT BOOK

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‘Reigniting the Passion for Innovative Teaching of Science and Mathematics in the VUCA World’

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ABSTRACT

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Theme

Reigniting the Passion for Innovative Teaching of Science and Mathematics in the VUCA World

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Preface

The International Conference on Science and Mathematics Education (CoSMED) 2023 marks the milestone tenth edition of this esteemed series, which has served as a cornerstone event since its inception in 2005. CoSMED stands as a pivotal platform initiated by the Regional Centre in Education for Science and Mathematics (RESCAM), aimed at fostering collaborative discourse among educators to address critical issues in science and mathematics education.

Under the resonant theme, "Embracing the Essence: Fostering the Flame of Progressive Science and Mathematics Education in the VUCA World," this year's conference emerges as a beacon of innovation and collaboration. This theme burgeoned from the conviction that convening scholars, educators, and budding teachers from diverse regions facilitates a profound exchange of insights, heralding emerging trends and pioneering pedagogical methodologies in science and mathematics education. Our earnest aspiration is that the discussion fostered within this conference will inspire educators to equip students with the aptitude to navigate the intricacies and seize the opportunities inherent in today's dynamic world. Indeed, it is imperative that educational paradigms evolve to authentically reflect the realities of the VUCA World.

The papers published in this Proceedings were selected through a blind peer-review process. The reviewers' recommendations were then conveyed to the authors for further improvement. During the final editing, the editors endeavoured to maintain the character and focus of the paper as intended by the authors) with only minor corrections and formatting.

On behalf of the organisers, we would like to extend our sincere appreciation to the Panel of Reviewers, all authors and everyone whose contributions have made the publication of this Proceedings possible.

Abstracts for Keynote Addresses

Keynote Address 1

Day 1: 31st October 2023 (Tuesday)|0900 – 0945|SEAMEO Hall|
Moderator: Dr Warabhorn Preechaporn

Education for Unknown VUCA World

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VUCA – (Volatility, Uncertainty, Complexity, and Ambiguity) describes the constant, unpredictable change that is now the norm in specific industries and areas of the business or educational world. VUCA demands that we avoid traditional, outdated approaches to management and leadership and day-to-day working. When there is an important event that affects the lives and well-being of many people worldwide. We need to know how to solve that problem. Therefore, education in today's world should be education that prepares us to face things that are yet to come that we do not know or predict before. The COVID-19 outbreak is a good example that makes us aware of how to adapt the education system to face the uncertain future. Education development focusing on creativity and innovation allows us to solve problems and modify the living system to adjust to various situations to survive. Applications of Innovative Strategies in Teaching–The learning process using SCAMPER, a technique for developing creativity and educational innovations, will help us survive in a VUCA world.

Keywords: VUCA, Creativity and innovation, SCAMPER

Keynote Address 2

Day 1: 31st October 2023 (Tuesday)|1400 – 1445|SEAMEO Hall|
Moderator: Dr Nanthini Jayaram

Fostering Teachers' Adaptive Expertise in Teaching Interdisciplinary Mathematics and Science

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Research has demonstrated that teaching science and mathematics in interdisciplinary ways can enhance learners' engagement and deeper learning of disciplinary knowledge and facilitate the development of twenty-first-century skills such as problem-solving and creative and critical thinking. The shift from disciplinary to interdisciplinary approaches to teaching and learning and the focus on teaching twenty-first-century skills requires teachers to become proficient at the skills and develop expertise across traditional disciplinary boundaries. Teachers are expected to become adaptive experts who can adapt quickly to unfamiliar, unexpected, and complex situations and apply professional knowledge flexibly, innovatively, and creatively in such teaching situations. Considered a hallmark of quality teaching, adaptive expertise is essential for teachers to innovate their teaching to enhance student learning and interest, yet little is known about its development. Empirical research on teachers' adaptive expertise has illustrated how teachers learn and develop effective teaching behaviors through situation-specific observations and interpretations of their actions in these situations (Yoon et al., 2019). Yoon et al. (2019) argue that discipline-specific adaptive expertise "addresses the need to not only have acquired content and pedagogical knowledge but to have a deep understanding of it to use such knowledge effectively" (p.892), as well as flexibly and deliberately. This presentation will share insights from a few research projects involving primary and secondary schools in Victoria, Australia. Using cross-case analysis of the interview data, teacher annotations on lesson plans, and video fragments for each lesson sequence, teacher adaptive expertise in interdisciplinary mathematics and science will be examined. The findings suggest that teachers' adaptive expertise levels vary depending on their understanding of science and mathematics and its connections in teaching. However, they also apply this understanding flexibly and deliberately in novel and non-routine teaching and learning situations. This study can contribute to knowledge about teachers' adaptive expertise development in interdisciplinary mathematics and science teaching.

Keywords: Interdisciplinary, creative and critical thinking, adaptive expertise

Keynote Address 3

Day 2: 1st November 2023 (Wednesday)|0900 – 0945 |SEAMEO Hall |Moderator: Dr Kamalambal Durairaj

Empower Your Critical Thinking: The Path to Achieve Innovation, Creativity and Success

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Dr Fong will present some scenarios and solutions to two mathematical problems. The problems are meant to invoke participants' critical thinking, which is one of this presentation's aims. Dr Fong will also show there are different levels of critical thinking. The higher your reach level, the more likely you will perform better. Some features of critical thinking guide participants in practising critical thinking skills. Often, we hear teachers lamenting that their students are not performing to solve mathematical problems. At the end of the presentation following the previous day's workshop, you will find a way for students to do mathematics. You will also realize that the key feature is to enhance your critical thinking skills and that you may be able to develop a pedagogy by practicing critical thinking and metacognition.

Keywords: Critical thinking, mathematical problems, metacognition

Keynote Address 4

Day 2: 1st November 2023 (Wednesday)|1400 – 1445|SEAMEO Hall |Moderator: Ms. Bhavani Ramasamy

Getting All Emotional About Science Communication and Teaching

Dr Graham Walker
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Emotions are a central part of effective science education (Alsop, 2001, 2005; Pekrun, Goetz, Titz, & Perry, 2002) and communication (Davies & Horst, 2016) – they are essential to connect with students and enhance learning – but which emotions are critical and what is the underlying mechanism of eliciting them? This keynote performance will showcase the role of emotions and motivational states, including surprise, interest, enjoyment, awe, curiosity, and intrinsic motivation, based on the presenter's PhD research and how they can be enhanced in classrooms, teacher demonstrations, and informal science learning contexts such as science centers. These psychological states will be dissected into components, allowing educators and science communicators to fine-tune audiences' emotional responses. These sometimes nebulous emotional states will be illustrated via intriguing, entertaining, and interactive demonstrations – you will feel the science! – in a performance that fuses science, presenting insights from emotion and educational psychology.

Keywords: Emotional, science education and communication, educational psychology

Keynote Address 5

Day 3: 2nd November 2023 (Thursday)|1030 – 1130|SEAMEO Hall|
Moderator: Ms. Sivaranjini Sinniah

Developing Teacher Leadership in Schools

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One of the most debated issues among individuals representing various education systems is the quality of education in their respective countries. In this regard, the 2007 McKinsey report mentioned that '' the quality of an education system cannot exceed the quality of its teachers''. However, we know that many factors influence the quality of an education system. At the forefront of these factors is the quality of teacher leadership, which has long been playing 'second fiddle' to school leadership. Traditionally, leadership has been associated with designated positions, especially in schools. As such, classroom teachers have always shied away from ''leadership'' roles, while we are aware that some of the best success stories relate to Science and Mathematics ''teacher leaders''. Why should a school have one great leader when it can have more? The mere existence of quality teachers and teacher leaders can catalyze and propel the school toward providing quality education. Who are these teacher leaders? Teacher leadership is not only confined to those with titles but rather teachers who are leaders without formal titles. The role of teacher leaders was evident during the COVID-19 pandemic through all the webinars, etc., that were conducted to support remote teaching-learning amid the VUCA environment. Hence, it is pertinent that institutions/schools continue to focus on developing teacher leadership talent with a focus on conceptual, technical, and humanistic skills among teachers in the quest to increase this pool of talented teachers who may one day assume the role of school leadership, etc. In tandem with this, in the past three years, spearheaded by Evolution Enterprise, we have instituted the Advanced Leadership Programme (ALP) led by officers from the District Education Office, and in addition, with another team, we have developed the Connecting-Dots-Learning (CDL) #cikgubantucikgu initiative in Malaysia. We have embarked on a journey of developing teacher leaders. The results have indicated that, given the empowerment, teachers can build a strong sense of professional capital and autonomy to address school needs through teacher-led interventions and initiatives. In conclusion, ''in terms of importance, the quality of school leadership cannot exceed the quality of teacher leadership in schools''. Teachers cannot take a back seat in curating the best teaching and learning in academic and co-academic activities in schools. We must accept and trust our teachers, who are designed to LEAD.

Keywords: Teacher leadership, quality teachers, "teacher leaders"

C-BHQ: A Cybergogy Approach on Student's Achievement in Born- Haber Cycle, Chemistry Learning Motivation, and Future-Ready Learning Skills

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Gamification, or game aspects in educational situations, has become a viable technique for increasing student engagement and academic achievement. This study investigates the impact of gamification, which represents the cybergogy approach in transformative teaching and learning (T&L) delivery, on students' achievement in the subtopic of the Born-Haber Cycle, learning motivation, and the development of future-ready learning skills. The study employs a quasi-experimental pre-test-post-test non-equivalent group design. A sample of 60 students from Penang Matriculation College are chosen and divided into treatment (N=30) and control (N=30) groups through cluster random sampling (intact group). The treatment group participates in gamified learning activities, whilst the control group receives conventional teaching. The outcomes of this study contribute to a better understanding of the effects of gamification on student success and learning motivation. It also investigates the potential of gamification in improving future-ready learning abilities using a cybergogy method. The findings provide valuable insights for educators and instructional designers interested in using gamification as a pedagogical strategy that fosters student engagement, achievement, and readiness for future learning. This research is significant for educational policymakers since it demonstrates the benefits of introducing gamified aspects into instructional design and curriculum development. Gamification can help cultivate lifelong learners with the necessary abilities to flourish in an ever-changing, technology-driven world by encouraging intrinsic motivation and delivering immersive learning experiences.

Keywords: Gamification/gamified learning activity, learning motivation, future-ready learning skills, cybergogy

Enhancing Higher Order Thinking Skills (HOTs) Through Project-Based Learning (PbL) in Preschool Classroom

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This study investigates the implementation of Project-based Learning (PbL) as a teaching approach to improve higher-order thinking skills (HOTs) among preschool children. This case study employed a qualitative approach to collect data using interviews, observation, and documentation. The participants were twenty-five preschool children aged 5 to 6 at a public school in Klang, Selangor. This selected preschool class teacher has more than three years of experience implementing PbL, and the findings show that PbL has proven to be a practical approach to improving early childhood critical thinking skills. By implementing systematically planned PbL activities, children showed significant progress in identifying problems, generating creative solutions, and considering different perspectives. Based on the study findings, implementing PbL in early childhood education is recommended to follow a structured process. This includes defining clear learning objectives, selecting exciting and relevant project topics, providing necessary materials and resources, and offering guidance and support throughout the learning process. This research contributes to the existing literature by providing insights into implementing PbL effectively to enhance HOTs in early childhood education. The findings underscore the importance of well-structured planning, implementation, and evaluation to maximise the benefits of PbL.

Keywords: Project-based Learning, Higher Order Thinking Skills, Preschool

Integrating Computational Thinking Skills into Chemistry: Impact on Problem-Solving and Gender

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In the 21st century, problem-solving skills are essential in education. To address this need, computational thinking (CT) skills have been introduced in schools to enhance students' creativity and critical thinking abilities, particularly within STEM fields. This study aims to identify the effectiveness of the Computational Thinking-Chemistry (CT-CHEM) Module in developing CT skills and examine its effects on gender. To that end, this study employed a quasi-experimental design involving 85 form four students in Malaysia. Three types of teaching approaches: the CT-CHEM module Plugged-in (CTP), the CT-CHEM Module Unplugged + Plugged-in (CTUP) and the conventional method (CM) were systematically designed and implemented. Students' CT skills were measured using the Bebras task, which justified validity and reliability, and a two-way MANCOVA was used to analyse the data. The results showed that students' algorithmic skill in CT was significantly higher in the CTP compared to the CTUP and CM groups. Still, the gender differences did not vary across groups. This study concludes that integrating CT skills through plugged-in activities will increase the algorithmic thinking skills of CT, reduce the gender gap in STEM fields, further improve STEM education and promote problem-solving skills among students.

Keywords: Computational thinking, plugged-in, unplugged, STEM education, problem solving

Reinforcing Assessment Skills of Science Teachers through Project E- STOMATA (Enhanced-Science Teachers Observing, Measuring, Assessing, Testing and Analysis of Learners' Products)

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Classroom assessment is one of the pressing concerns that must be addressed in implementing the K to 12 science curriculum. Challenges the teachers encounter include inappropriate or misaligned classroom assessment for the learning competency covered during the teaching-learning process. This study was conducted to reinforce the assessment skills of science teachers through project E-STOMATA. This likewise identified the assessment methodologies used and the perceived advantages and disadvantages of the current assessment methodologies. The mixed methods of research applying both qualitative and quantitative methods were used. Non-probability sampling, specifically purposive sampling, was adopted to select the participants. Results revealed that the respondents always employ the top five assessment methodologies: multiple-choice questions, worksheets, recitation, matching type, and self-assessment. Various parameters are considered by the science teachers in employing assessment methodologies, which include ease of use, alignment with the learning competencies, relevance, time for writing and checking, manageability for both teachers and learners, appropriateness to learners, reliability, validity, fairness, and inclusivity. With this, the teachers' assessment skills in the field can be reinforced by implementing the project in science education. The results of this study can also serve as a baseline in crafting policies in science education, specifically on implementing appropriate assessment in science teaching.

Keywords: Project E-STOMATA, Science assessment

AP Model: A Visualisation Tool for Learning the Application of Boyle's Law among Matriculation Students

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This study focuses on states of matter, specifically examining the movement and attraction of gas particles and the changes that occur at a submicroscopic level. Many students need help grasping these concepts, particularly Boyle's Law. This study aims to improve students' performance by employing the Air Pump (AP) Model as a visualisation tool for teaching Boyle's Law. The research was quasi-experimental, involving 70 Science stream students in a two-year programme at a Matriculation College. The participants were divided into two groups: one received instruction using the AP model (the treatment group), while the other used the conventional method (the control group). Data collection methods include pre-test, post-test, interviews and questionnaires. Quantitative analysis techniques were employed, such as independent sample t-tests and paired t-tests. The findings revealed a significant increase in mean scores for the AP group, rising from 48.29 to 62.29, compared to the control group using the conventional method (CM). The paired t-test results showed a significant improvement in the AP group (p-value: 0.000), while the CM group did not exhibit substantial improvement (p-value: 0.160). These results suggest that the application of the AP model positively impacts students' performance compared to the traditional teaching method. Furthermore, questionnaires and interviews indicated that the AP model enhances students' motivation to learn Boyle's Law. This study recommends further exploration of the AP model's applicability in Physics education and instructional development.

Keywords: Chemistry, Boyle's Law, submicroscopic level, visualisation tool, AP model

A Kirkpatrick Model Evaluation of the Southeast Asian Science Teacher Training

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This article evaluated a regional-level professional development course hosted by an intergovernmental institution. The Southeast Asian science teacher attended the four-week courses to address the educational challenges in different contexts and enhance the teacher's capacity to support quality education in the region. To achieve a far-reaching and long-lasting positive effect, this course also encourages amplifying the course content to respective professional settings through the 'Multiplier Effect' projects. Nineteen (N=19) participants were sampled purposely among the attendees. Kirkpatrick's three-level evaluation model was used to measure the course's impact. The teaching environment of workshops, knowledge about new teaching and learning methods and behaviour changes during the workshops were gauged. Qualitative and quantitative data were collected to learn the impact of interim and post-course sessions post-course. Most participants perceived the course delivery as positive at Kirkpatrick's model's first and second levels. The interim impact data shows that the participants acquired mastery of the course content with a mean gain of 0.98 from the mean post-test score of 3.67. ± 0.98, and the mean pre-test score of 2.73 ± 0.86. However, at the third level, the post-programme surveys revealed that 50% of participants reported seeking and seizing opportunities to create positive change within their professional settings. The findings show that the course amplifies the targeted community despite a decrease in the impact of interim and post-course. This in-house assessment provides feedback to the host institutions and is a valuable tool for continuous improvement and accountability of resource allocation.

Keywords: Regional training, Southeast Asia, science education, programme evaluation, multiplier effects

Enhancing Understanding of Redox Reactions through Practical Engagement: A Study on the Integration of the Chem Redox Kit With Microscale Teaching of Chemistry

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Redox reactions, fundamental to chemistry and technology, often challenge students due to their abstract nature. This research explores the effectiveness of integrating the Chem Redox Kit with microscale teaching techniques to deepen students' conceptual understanding of redox reactions. One hundred sixty-eight students from SMK Ave Maria Convent, Ipoh, participated in this study. The intervention aimed to enhance students' ability to explain key concepts of redox reactions in various chemical reactions, identify electron transfer processes and understand the redox reactions occurring in electrolytic cells and chemical cells. Quantitative assessments revealed a significant improvement in students' self-reported understanding, with percentage improvements ranging from 25% to 100%. Qualitative insights from participants highlighted shifts from abstract challenges to practical engagement and clarity in explanation. Challenges evolved from struggling with abstract concepts to addressing specific comprehension and application aspects. At the same time, experiences with hands-on chemistry kits transitioned from limited prior exposure to positive engagement with the Chem Redox Kit. These findings underscore the pedagogical value of practical, hands-on experiences in chemistry education. Integrating the Chem Redox Kit with microscale teaching techniques improved students' comprehension and boosted their confidence and enthusiasm for redox reactions. This research offers evidence-based strategies for educators to bridge the gap between theoretical knowledge and practical understanding of redox reactions, ultimately enhancing students' chemistry education.

Keywords: Redox reactions, Chem Redox Kit, microscale teaching, student comprehension, hands-on learning, chemistry education

The Effects of Tabletop Games among Form 4 Students in Critical Thinking Disposition in Learning Periodic Table of Elements

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In contemporary education, fostering critical thinking disposition is a paramount goal. Educators have explored a diverse range of instructional methods, including problem-based learning, collaborative activities, and inquiry-based approaches, each meticulously designed to cultivate critical thinking disposition in students. Among these innovative approaches, the integration of tabletop games has notably emerged as a promising strategy for nurturing critical thinking skills. This study investigates the effects of incorporating tabletop games into Form 4 chemistry class and its effects on students' critical thinking disposition. Seventy-eight Form 4 students underwent two distinct pedagogical contexts: a control group exposed to conventional instructional methods and an experimental group immersed in tabletop game-based learning. Little Periodic was thoughtfully adapted from "A Game of Elements" and selected as a pedagogical instrument. Comprehensive pre- and post-assessments were administered to gauge changes in critical thinking disposition. The independent sample t-test was methodically employed to examine the differential mean scores between the control and experimental groups. Statistical analysis yielded robust evidence ($p < 0.05$) in favour of the experimental group, indicating that implementing tabletop games significantly enhanced critical thinking disposition. Furthermore, students within the experimental group self-reported increased critical thinking disposition and a greater inclination toward critical inquiry. This investigation underscores the potential of tabletop games as productive tools for cultivating critical thinking disposition among Form 4 Chemistry students. The findings posit tabletop games as valuable adjuncts to conventional instructional methodologies, offering a tangible means of promoting a disposition toward critical thinking among students.

Keywords: Critical thinking disposition, tabletop games, little periodic, independent sample t-test

Exploring Students' Perceptions and Abilities in Conditional Probability Problem-Solving

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This study investigates students' perceptions and abilities in solving conditional probability problems. A combination of data collection methods was employed for this study. A semi-structured interview was conducted with six students selected through purposive sampling from a matriculation college. The interviews aimed to gain insights into students' perceptions and challenges related to conditional probability problem-solving. Thematic analysis was employed to analyse the collected data. This qualitative approach allowed for identifying themes and recurring issues in students' responses and problem-solving processes. In addition, students' work on exercises involving conditional probability problems was analysed to understand their abilities further and their thought processes. By examining students' perceptions and problem-solving abilities, this study aimed to understand students' challenges in conditional probability comprehensively. The findings of this study shed light on the specific areas where students struggled to solve problems related to conditional probability. These insights can inform the development of targeted learning environments, instructional strategies and interventions to improve students' learning of conditional probability. The study contributes to the broader field of mathematics education by enhancing practitioners' and academics' understanding of students' perceptions and abilities in conditional probability problem-solving. The findings of this study have implications for instructional practices and curriculum development, aiming to enhance students' understanding and proficiency in conditional probability problem-solving. By addressing the identified needs, challenges and suggestions, educators can provide more effective support and interventions to improve students' learning outcomes in this area of mathematics.

Keywords: Perceptions, abilities, conditional probability, problem-solving

Preliminary Investigation: Teachers' Perception of Computational Thinking Skills for Mathematics Classroom

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This paper investigated primary school mathematics teachers' perception of CT in mathematics classrooms. Two virtual webinars were conducted to cover the teaching and learning mathematics activities. At the end of the webinars, a questionnaire to acquire teachers' perceptions of CT was disseminated to participants. The questionnaire consists of teachers' comprehension of the CT concept, teachers' interest in problem-solving abilities related to CT, perceptions of the integration of CT in teaching and learning practice, and perceptions of a teacher's competencies in teaching and learning using CT. The survey forms were distributed using Google Forms and were emailed to the respondents. SPSS and Nvivo software were used to analyse the data collected. Eighty-four teachers attended the webinars, and only 41 primary school mathematics teachers responded to this study. The studies demonstrate that teachers comprehend the concept of cognitive theory and value cognitive skills in their classroom activities as a component of the thinking process. However, it is essential to consider teachers' concerns about time constraints when utilising these skills to improve students' learning. The study will show that CT skills can be used for problem-solving in mathematics classrooms, which is essential to prepare future teachers and students for CT skills. The participants also stated that CT skills are necessary for students in the future because the students can apply CT skills to solving problems in daily life.

Keywords: Computational thinking, mathematics classroom, problem solving

Impact of Digital Teaching Aids on the Academic Performance of Year 4 Pupils in Coordinates

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This quasi-experimental study aimed to assess the impact of digital teaching aids on the academic performance of Year 4 pupils in coordinates. The participants involved in this study were two classes comprising 52 pupils from a primary school in Penang, which were selected using cluster sampling. The research instrument was built based on the Mathematics Standard-Based Curriculum for Primary School (DSKP). Pre-test and post-test evaluations were carried out for both the experimental and control groups to gather data. According to the literature review, common misconceptions faced by pupils in learning coordinates included ordered pair misconceptions and

visualisation problems. To address these issues, the experimental group received an intervention involving digital teaching aids, while a traditional teaching method was applied to the control group. Descriptive and inferential statistics with a quantitative approach, such as mean, standard deviation, paired samples t-test, and independent samples t-test, were utilised for this research. Data analysis indicated that using digital teaching aids significantly improved pupils' achievement in coordinates, as demonstrated by a significant difference between the mean marks of pre-test and post-test within the experimental group. Moreover, the outcomes also revealed a substantial difference in the mean marks between the experimental tal and control groups. The findings of this study bear notable implications for various education stakeholders.

Keywords: Digital teaching aids, academic performance, coordinates, primary mathematics, pre-test and post-test

What We Have Learned about Teachers' Questioning from 100 Mathematics Lessons Visiting?

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Following the release of the New Math Curriculum Guideline (MCG) in Taiwan in 2014, which emphasised mathematical literacy, researchers have sought to examine its impact on mathematics instruction in the classroom. As mathematical tasks are fundamental to teaching and learning and are shaped by teachers' posing and questioning, this study explores the types of mathematical tasks teachers employ in their teaching. How did teachers guide students to learn and solve mathematical tasks by their questioning? Which learning focus was emphasised when teachers implemented mathematical tasks? The teachers' teaching practice in the classroom could give us an insight into evaluating the influence and effectiveness of the national MCG on teachers' teaching and students' learning. A case study was adopted as a method in this study. Thirty-one elementary teachers from 11 urban, suburban, and rural schools participated in this study, and they had different academic backgrounds and teaching experiences. Three lessons with varying mathematics topics, including Number and Quantity, Geometry, and Algebra, were videotaped for each teacher. Ninety-three mathematics teaching videos were collected and analysed. To achieve the purposes of this study, researchers developed two instruments, which focus on Teachers' follow-up questioning, types and focus of mathematics tasks for analysing teachers' teaching practice. The analytic reliability of the two instruments is 89 and 1, respectively, for teachers' questioning and task types through two experienced analysts working on the same teaching video comparison and analysis. After determining the reliability, we started analysing all the teaching videos. The results of this study indicated that most of the questions the teachers used were closed-ended questions with short and immediate responses from students, which focused on helping students classify and understand the meaning of math concepts and problems. Only 5 % of the questions the teachers used were asking students to do mathematics reasoning and explanations about their problem-solving. Eighty-five per cent of tasks the teachers implemented in teaching were low-cognition tasks, which emphasised memorising mathematics facts or mastering arithmetic skills. During the implementation, 18% of the teaching focused on mathematics reasoning and application. The results of this study showed that teachers' teaching performance in math lessons did not satisfy the requirements and expectations of our NCG, which emphasises mathematics inquiry and reasoning. The findings of this study help us understand what's going on in the math classroom after our NCG is published and evaluate the effectiveness of our NCG implementation. According to our findings, we should shorten the gap between practice and NCG, including improving pre- and in-service teachers' programmes, understanding the teachers' challenges and providing support.

Keywords: Mathematics teaching, teacher's questioning, types of problems

Enhancing Mathematics Teachers' Diagnostic Competence through the SMART Test Professional Learning: Challenges and Opportunities

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Some studies reported that Indonesian teachers faced difficulties conducting the diagnostic assessment. An online diagnostic test, SMART Test, was introduced to Indonesian teachers through a Professional Learning (PL) session to assist them with this issue. This study aims to evaluate the impact of the PL in enhancing teachers' diagnostic competence. Guskey's five-level evaluation framework was used to assess the effect of the PL on teachers' attitudes and knowledge, school support, changes in classroom practices, and student learning outcomes. The participants of this study are ten Indonesian mathematics teachers, five primary school teachers and five junior secondary mathematics teachers. Data were obtained using the teacher's journal diary, survey, and semi-structured interviews. The results indicated that the SMART Test PL positively influenced teacher attitudes and content knowledge about diagnostic assessments. Furthermore, the teachers also used the analysis results and the suggestion from the SMART Test to change their teaching practices, which positively influenced students' learning outcomes. Teachers experienced challenges during the implementation due to the language barrier and the need for more technology tools. The SMART Test PL shows potential for enhancing teachers' diagnostic competence.

However, further research is needed to examine the change in teachers' practice and how it affects students' mathematical thinking.

Keywords: SMART Test, Online Diagnostic Test, Teacher Professional Learning, Teacher's Diagnostic Competence

On the Nullity of Some Families of R - R-Partite Graphs

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A graph is denoted by $G = (V, E)$ where $V = \{v1, v2, ..., vn\}$ is a finite set of vertices and E is a finite set of edges. The order of graph G is the number of vertices denoted by n, while the size of graph G is the number of its edges denoted by m. A square matrix representing a graph G is called its adjacency matrix $A(G)$. The adjacency matrix of G of order n is the $n \times n$ symmetric matrix $[aij]$ such that $aij = 1$ if vi and vj are connected and 0 otherwise, for any pair $vi, vj \in V$. Eigenvalues are the unique set of scalar values that are associated with the set of linear equations most probably in the matrix equations. The main focus of this paper is the nullity of a graph G, denoted by $\eta(G)$ and defined to be the total number of the eigenvalue zero in the spectrum of a graph. The spectrum of a graph G is a two-row matrix; the first-row elements are the distinct eigenvalues of its adjacency matrix $A(G)$, and the second-row elements are its corresponding totals. Furthermore, the rank of G, denoted by $rank(G)$, is also the rank of $A(G)$, that is, $rank(G) = rank(A(G))$. The rank of $A(G)$ is defined as the maximum number of linearly independent row/column vectors in the adjacency matrix $A(G)$. In addition, given that G is of order n, it is known that $\eta(G) = n - rank(G)$. Thus, any result about rank can be stated in terms of nullity and vice versa. Now, the r-partite graph is a well-known graph. It is a graph G where vertex set V is partitioned into r nonempty subsets $P1, P2, ..., Pr$ so that no edge joins two vertices in the same partite sets. In this paper, a particular class of families of r-partite graphs was examined and represented by its adjacency matrix. It identified the rank of graph *G, and* then the nullity of G was determined.

Keywords: Adjacency matrix, nullity of a graph, r-partite

Anakku Bitara (Proakbi) Programme: Indicators for Literacy and Numeracy Mastery of Year 5 and Year 6 Pupils

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The Literacy and Numeracy Programme (LINUS) and the Literacy and Numeracy for Primary School (PLaN) were implemented by the Ministry of Education Malaysia (MOE) to ensure the mastery of 3R (Reading, Writing and Arithmetic) among pupils in stage one primary education. The main purpose of *the Anakku BITARA* Programme (ProAKBI) for Stage Two pupils (Year 5 and Year 6) was to identify those who failed to master 3R based on the prescribed constructs by utilising literacy and numeracy mastery identification (2Plan). Three thousand nine hundred fifty-eight Performance Level 1 (TP1) and Performance Level 2 (TP2) pupils from Year 5 and Year 6 were involved in this study. To avoid intervention issues such as unfocused teachers and teacher transfer problems, the Melaka State Education Department created the Progress Indicator Card (PIC), an innovation to record scores for each pupil's construct for teachers to implement an intervention based on constructs that have not been mastered. Mastery of each construct will be recorded through an indicator graph that reflects the pupils' progress. This innovation is likely to assist teachers and parents to overcome the 3R issues with focused interventions before primary school pupils' step into secondary school.

Keywords: Literacy and numeracy, 3R, intervention, mastery

The Implementation of Integrated STEM Project-Based Learning (PBL) e-Module

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To empower Science, Technology, Engineering and Mathematics (STEM) in education, the Curriculum Development Division has taken the initiative to develop and implement an Integrated STEM Project Based Learning (PBL) e-module as a guide for teachers to conduct teaching and learning through project-based learning. This study was conducted to see the effect of implementing an Integrated STEM PBL e-module at school. Sixty-four selected schools have implemented various Integrated STEM PBL projects involving a combination of several STEM and non-STEM subjects. A survey was conducted on all schools involved. Data collection is carried out in the form of questionnaires and interviews with teachers and students. The findings show a positive impact in several aspects, such as STEM-based teaching planning, the implementation of Integrated STEM PBL activities and the assessment based on the STEM approach. The results of the interview found that 88.9% of the students had an interest in STEM subjects and were interested in continuing their studies at a higher level in the STEM field. Integrated STEM PBL is expected to attract more students to venture into STEM fields at the school and higher education levels, be able to deal with challenges, and be competitive at the global level.

Keywords: STEM Education, Project Based Learning, e-module, integrated learning

Towards a Framework for Understanding the Meaning of Fractions

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Researchers and teachers have recognised the importance of learning fractions in schools worldwide due to its function in our daily lives and the various challenges students face in understanding the concept of fractions. Efforts need to be made to define fractions to help teachers and students develop knowledge and competence in fractions and mathematics in the VUCA world. Therefore, this study proposes a framework to develop students' understanding of the meaning meaning of fractions. The framework for understanding the meaning of fractions based on four main dimensions, namely fraction is partitioning, fraction is iterating, fraction is a number, and fraction has size, was proposed and needs to be emphasised among students. The proposed framework is significant for designing the teaching of fractions, focusing on building a comprehensive and in-depth knowledge of fractions rather than separating one dimension from another.

Keywords: Fractions, Mathematics teaching, framework of fractions, the meaning of fractions, Fractions understanding

Use of Artificial Intelligence "Checkmate": Helps Improve Mastery of Numbers and Operations through Student-centred Approach

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This research was conducted to improve the students' abilities in number training and operations with the help of the Artificial Intelligence "CheckMath". Early observations of the researchers found that the students could only solve the problem of numbers and operations with the help of researchers. Pupils need more confidence in solving training problems in this area. Therefore, the researchers have implemented a more interactive learning intervention using "CheckMath". This learning is applied based on the researcher's concern for the problems students face in mastering this field. This digital intervention concept applies the idea of 21st Century Learning (PAK-21), which is student-centred learning. In the learning standards outlined in the assessment curriculum standards document (DSKP), students can solve mathematical sentences involving whole numbers, fractions of millions and decimals of millions for basic operations and combined operations. Using the action study method, the researchers conducted pre-test, post-test, interviews, and observations on ten excellent year six students to test the effectiveness of "CheckMath" in helping students improve their mastery of numbers and operations. The researchers also suggest that mathematics teachers use this digital alternative approach inside and outside the classroom. This research is also expected to drive efforts to foster students towards an interest in Mathematics in general.

Keywords: Artificial Intelligence "CheckMath", 21st Century Learning (PAK-21), student-centred learning

Educators' Perception of Programming Module on Mathematics Instruction for Primary School

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This paper aimed to assess the educators' perceptions of implementing programming modules in mathematics instruction at primary schools to enhance pupils' computational thinking skills and motivation. The study employed a qualitative approach. Specifically, the instrument comprises semi-structured interviews via a purposive sampling method. Eight respondents among mathematics educators from different institutions were involved. This study reveals that most respondents have a favourable view of programming modules integrated into mathematics education in primary school. Most respondents concur that such a module can boost student learning motivation. However, they need more programming application skills. Hence, the findings suggest that the mathematics curriculum for primary school needs a structured module in programming. Consequently, this study recommends the development of a module that integrates programming in mathematical learning to assist primary school mathematics educators in enhancing pupils' computational thinking and boosting their learning motivation in mathematics.

Keywords: Mathematics, programming, computational thinking, motivation, instructional module

A Study of Pre-Service Teachers' Interest in Fundamentals of Programming Toward Achievement in Decision Mathematics Courses

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Basic programming refers to the basic knowledge and concepts required in software development or writing code using a programming language. Programming basics is an essential first step for anyone who wants to learn and master programming skills. This study aims to investigate whether there is an impact between interest in the basics of programming and achievement in the subject when attending the Decision Mathematics course at the Institut Pendidikan Guru Kampus Pulau Pinang (IPGKPP). The sample consisted of 66 IPGKPP students from Mathematics courses. The instrument used is a questionnaire with a choice of five Likert scales. The statistical test is an independent samples t-test and analysis of variance (ANOVA) with the data analysed using SPSS (Statistical Package for the Social Sciences). There is a positive impact between interest in the basics of programming, gender and achievement in Decision Mathematics. The results showed no significant difference between male and female students but an essential difference among different achievements in interest in programming. The results also found that low-achievement students` interest in programming was the lowest of all respondents compared with high-achievement students`. In conclusion, the basics of programming and the subject of mathematics are relevant because the structure of both, which is logical, helps understand and solve problems. However, interest is not the only factor that affects achievement in mathematics.

Keywords: Programming, achievement, decision mathematics, pre-service teachers

Mnemonics Strategy in Enhancing Graph Sketching Skills

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This paper aimed to present the impact of using the mnemonics strategy (acrostics) to improve students' graph sketching skills and enhance students' confidence in sketching graphs. This research involved seven students who enrolled in the course Mathematics SM015 at Kolej Matrikulasi Pulau Pinang during the academic session 2022/23. The cognitive load theory serves as the theoretical framework adopted to achieve the aim of this study. The Kemmis and Mctaggart model is applied in this study. Pre-test and post-test were conducted to investigate students' performance after implementing the mnemonic strategy in graph sketching. The mnemonic strategy improves students' graph sketching skills and enhances confidence in graph sketching. From the paired-sample t-test, the p-value <0.5 implies a significant difference in the pre-test and post-test means. Furthermore, the higher mean of the post-test indicates that students significantly improved in sketching graphs after introducing the mnemonics strategy. The students are more confident when sketching graphs after implementing the mnemonic strategy.

Keywords: Graph sketching, mnemonic strategy, cognitive load theory

Teacher Sharing Classroom (TSC) Basics Computer Science Teacher towards the Digitalisation of Teacher Education in Perak State (Pilot Study)

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Nowadays, teachers need knowledge and skills to strengthen the quality of teaching and learning for students' achievement. However, some teachers (mentee teachers) are less skilled due to non-teaching options or lack of experience teaching basic computer Science subjects. In addition, constraints in terms of location and time cause mentee teachers to lack exposure and knowledge sharing from expert and experienced teachers (mentor teachers). Therefore, this study aims to improve the skills of mentee teachers in teaching and learning the Basics of Computer Science through a co-teaching approach. The Teacher Sharing Classroom (TSC) programme is a teaching and learning sharing programme of Mentor Teachers from other schools to mentee teachers from different schools that is implemented online using a co-teaching approach. This study was carried out quantitatively in 30 schools of mentee teachers who taught in Form 1, Form 2 and Form 3, and there are three mentor teachers. The findings showed that the co-teaching method provides new knowledge to the mentee teacher. The worksheets and materials the mentor teacher used gave the mentee teachers new ideas on planning, teaching, and learning lessons for topics and understanding complex issues. In addition, the mentor teacher's questioning technique can stimulate students to engage in teaching and learning sessions in the classroom actively. In conclusion, this study provides a platform for mentee and mentor teachers to exchange opinions and share teaching and learning techniques and strategies. The study also supports the digital education policy, where this study uses new methods for future education.

K**eywords**: Co-teaching, fundamentals of computer science, national digitisation policy, mentor teacher, mentee teacher, technology

Engagement of Jahai Indigenous Students in Integrated STEM Learning through the Kombucha Tea Fermentation

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Engineering is one of the essential elements of STEM education. The Engineering Design Process (EDP) is a new trend within science education reform. EDP can foster students' engagement in science learning by sustaining their cognitive, behavioural, and emotional interests, commonly called active engagement. However, most science teachers still need more information regarding the application of EDP in teaching and learning science. Fermentation of sweetened black or green tea by a symbiotic culture of bacteria and yeasts, known as Kombucha tea, is emerging as an appealing STEM learning environment that can provide primary educators with solutions to address the complex nature of students' engagement in contemporary practice. This study explores how the integrated STEM learning with Kombucha tea fermentation lends itself to the pedagogical approach of EDP (STEM-Kombucha) to enhance students' engagement in the context of Indigenous education. Characterising the relationship between pedagogy, integrated STEM learning, Kombucha tea fermentation and students' engagement as a complex problem, the study followed an action research design to develop an integrated STEM learning experience for the Jahai tribe Indigenous students. A teacher-researcher conducted this study with 16 students in a rural area of Royal Belum Rainforest, Gerik, Perak, Malaysia. Data were gathered through the post-experience survey, teacher observations, and student work. The findings illustrate that STEM-Kombucha promotes a highly immersive environment where students can actively engage in the learning process to construct an experience and understanding of life processes and factors affecting the growth and usage of microorganisms. While this study focused on how integrated STEM learning through EDP with Kombucha tea fermentation might enhance students' engagement, it also illustrates an innovative instructional approach not commonly found in contemporary Malaysian primary educational environments.

Keywords: Teacher action research, Kombucha tea fermentation, engineering design process, engagement, Indigenous students

Virtual Reality Trainers for Students with Disability: Analysis of Students' Motivation and Motor Performance

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Despite the growing policy, educational, and political concern surrounding the progressive trend towards enrolling students with disabilities in regular public schools, few studies have examined the effective inclusion of Students with Learning Disabilities (SLD) in teaching and learning. As a fundamental human right, inclusive education necessitates educators exploring more ways to include SLD students. Virtual Reality (VR) offers a highly motivating learning environment, combining 3D virtual settings with technologically advanced modes of interaction. VR provides an interactive experience where individuals can become immersed in computer-generated environments. Nevertheless, there is limited research on using VR for Students with Learning Disabilities (SLD). Physical Education (PE) is a compulsory subject in Malaysia, aimed at developing skills, knowledge, values, and attitudes for maintaining a healthy lifestyle. Numerous studies have explored the use of VR to enhance PE learning. Therefore, this study examines the effectiveness of VR trainers in teaching PE to students with learning disabilities. A VR application is being developed as part of this study, and users will be asked to provide their opinions. The study evaluates the motor performance and motivation of the experimental group to measure the effectiveness of VR trainers in facilitating SLD learning. The results demonstrate that combining immersive technology with motor learning theory successfully motivates SLD students and improves their motor performance scores in PE learning.

Keywords: Disability, inclusive education, computer-generated environments

Evaluation of STEMEC Program Implementation in Malaysian Primary Schools: A Pilot Test of Input, Process, and Product Assessment

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The Ministry of Education (KPM) initiated the STEM Executive Consultation (STEMEC) program in 2019 to develop exemplary schools that implement integrated STEM education holistically using project-based learning methods. To ensure the feasibility of this programme in primary schools, an evaluation study needs to be conducted. Considering that this programme is still in the educational programme phase under the Malaysian Education Development Plan 2013-2025 initiative, it is necessary to gather data to determine whether it needs improvement, should be maintained, or should be replaced with a more effective alternative. The assessment of this program utilises the CIPP Model by Stufflebeam (1971), which focuses on evaluating the dimensions of input, process, and product. This pilot research employed a survey approach with a quantitative methodology. The survey questions were developed by adapting previous studies and then distributed to 30 respondents who were teachers involved in the STEMEC programme. The data collection was facilitated through the Google Forms platform. The study's findings revealed that the respondents' perception of the STEMEC programme implementation from the input, process and product evaluation in the CIPP Evaluation Model was high. The results of this study suggest that this program should be maintained. Adequate teacher training, sufficient facilities and materials, support, guidance, and monitoring are essential elements for the successful implementation of this programme.

Keywords: Programme STEMEC, CIPP model, programme evaluation

Survey on Computational Thinking Skills with Internet of Things (IoT) Activities: Assessing Educators' Perspectives

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Computational thinking abilities are considered necessary in the age of rapid technological growth. It is critical to grasp educators' viewpoints on the importance of computational thinking skills in Internet of Things (IoT) activities as IoT technology integration becomes more common in educational settings. In the context of IoT activities, this study intends to investigate educators' understanding, views, and practices linked to computational thinking skills. This study aimed to introduce the basics of electronics using Arduino microcontrollers and create circuits with the breadboard. The data collection method was mainly through a survey method and a Guttman scale questionnaire consisting of dichotomous and open-ended questions. Preliminary findings from the survey highlight the importance of educators' awareness and understanding of computational thinking skills in the context of IoT activities. The survey's findings will illuminate how computational thinking skills are currently embedded into IoT activities, as well as the assistance and materials educators need. This knowledge can help design curricular standards, policy suggestions, and targeted professional development programmes to improve educators' ability to encourage computational thinking skills through IoT activities. This poll adds to the more extensive discussion on the successful integration of IoT technology and computational thinking in educational contexts by understanding educators' perspectives.

Keywords: Computational thinking skills, Internet of Things, IoT, educators, survey, professional development, curriculum integration.

My Lovely Pet

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Science Process Skills are basic thinking skills students need to understand a science concept. This study aims to enhance science process skills by applying a project-based learning method entitled 'My Lovely Pet'. Reflection on past teaching and learning sessions showed that students needed help in the skill of classification, especially in the topic of animals, where they needed help to identify similarities and differences based on the characteristics of the particular animal. The target of this study consists of 5 Year 2 students from the Special Education class who have not yet mastered the 3M skills, namely Reading, Writing, and Arithmetic. This project involves initial observation of the animal they commonly see around the school, which is a cat. Students are asked to narrate their observations of the cat using their understanding and words. The teacher will guide them in finding information about their favourite animal based on verbal guidance and instructions during the teaching and learning session, as the students still need to improve their reading skills. The result of their project is an attractive scrapbook that will be displayed in the classroom and can be used as a teaching aid. Based on observations and interviews, the teacher found that the students showed positive confidence in answering all questions about the project they produced. The students also felt happy because they could learn while playing with their favourite animals.

Keywords: Project-based learning, science process skills, special education students.

Higher-Order Thinking Skills in Teaching and Learning of Substance Movements across the Plasma Membrane

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The purpose of this study is to identify the level of higher-order thinking skills by integrating project-based learning, *Model Kreatif Terarah*, constructivism theory, visual charts, mind maps, and concept maps for teaching the Movements of Substances Across the Plasma Membrane using a well-developed BIO Three Module. A quantitative approach with a quasi-experimental research design was chosen to answer two research questions and hypotheses. A Critical Thinking Appraisal Watson Glacier Questionnaire was used in this study. Sixty students were randomly selected as respondents. The descriptive analysis revealed that the level of higher-order thinking was 46 per cent for the post-test and 39 per cent for the pre-test. The t-test was then used to compare the treatment and control groups' levels of higher-order thinking skills. Initially, the groups' higher-order thinking skills were equal ($p > 0.05$, 0.983). After implementing the module, there is a significant difference between the groups ($p < 0.05$, 0.000). This study hopes to improve students' high-level thinking skills by employing the BIO Three Module as teaching aids. The theories and models used in the conceptual framework can be applied to develop modules for other topics in Biology.

Keywords: Module development, mastery concept, higher-order thinking skills, project-based learning, and constructivism.

The Integration of Blended Learning with the Digital Platform Wakelet in Organic Chemistry Learning For Matriculation Science Students in Semester Two

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Readiness and preparation of students before entering the classroom are crucial for learning organic chemistry. However, some students need more resources and platforms to adequately prepare themselves before entering the classroom. This study explores students' perceptions of the integration of Wakelet as an interactive digital platform in blended learning on organic chemistry. A total of 10 students were selected as respondents for this study. Data was collected using semi-structured interviews and document analysis and later analysed using a thematic approach. Three themes emerged from this finding: i. Systematic; ii. Effectiveness; and iii. Ease and flexibility. The research findings indicate that this integration makes the students' learning process in organic chemistry more systematic, faster, and more accessible and enhances students' self-directed learning, engagement, and motivation in learning organic chemistry. Students state that using the digital platform, Wakelet makes it easier to search for their notes or work. They also agree that Wakelet can help them efficiently manage their learning in Chemistry. However, support and training are needed to help students master the skills and become familiar with this new application. The implications of this study suggest that Wakelet is a suitable digital platform for instructional planning, managing learning materials, and tracking students' activities in blended learning.

Keywords: Wakelet, organic chemistry, blended learning, matriculation and chemistry learning

Assessing General Biology Self-Learning Modules through a Science-as-Practice Lens

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Curricular materials teachers design are pedagogical tools and artefacts of their participation in the planned curriculum and their teaching context. Teacher-designed Self-Learning Modules (SLM) were distributed in response to students' needs for distance learning during the COVID-19 pandemic. These SLMs reflect the current science curriculum but were revised for individualised instruction for fewer learning competencies. They even concretise science instructional practices that could be assessed relative to particular visions of science curriculum reform. In the United States, the Next Generation Science Standards (NGSS) represents a K to 12 curricular reform that emphasises teaching science as practice. In this study, the General Biology SLMs of a local school were assessed through the science-as-practice lens using the Educators Evaluating the Quality of Instructional Products (EQuIP) rubric. This rubric checks the quality of evidence in the instruction based on the following criteria: NGSS 3D Design, NGSS Instructional Supports, and NGSS Monitoring Students Progress. Our analysis revealed that the General Biology SLMs that certain aspects of the NGSS 3D Design were applied, but their execution could still be improved. In addition, there is adequate evidence of instructional support for student's learning. However, due to the SLM's self-learning design, there needs to be more evidence that it monitors student progress. The implications for designing science curricular materials and science education reform will be discussed.

Keywords: NGSS, science as a practice, self-learning modules, EQuIP Rubric

The Effect of Predicting, Observing and Explaining Learning Strategies Integrated Visualisation on Students' Conceptual Understanding in Chemical Bonding

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In chemistry, Chemical bonding is one of the vital and basic concepts. It is a topic that students commonly find problematic, developing a wide range of alternative conceptions. Meanwhile, integrating the 3MV module could enhance students' understanding and reduce misconceptions about chemical bonding. This research investigates the effects of the 3MV module on improving conceptual understanding and reducing misconceptions about chemical bonding. A teaching and learning module based on the 3MV learning strategy (3MV module) was built to guide teachers in implementing this strategy. The learning video disseminated through the TikTok platform was developed and integrated into the module. A quasi-experimental study was designed with a sample of 93 students divided into control and experimental groups. The control group used a teaching and learning module integrated with the 3M learning strategy. In contrast, the experimental group used a teaching and learning module designed with a 3MV learning strategy (with learning video through the TikTok application). This study used pre- and Post-test using three-tier diagnostic tests of chemical bonding and structure questions, and analysis shows that the data were normally distributed. Furthermore, there was no significant difference between the experiment and control group for student achievement in the pre-test ($t(93) = .289$, $P > 0.05$). Students' achievement in post-test score analysis revealed a significant difference between the experimental and control groups ($t(93) .000$, $P < 0.05$). Analysis of students' level of understanding of the concept using the Certainty of Responses Index (CRI) technique, which is descriptive analysis to categorise students into two main categories: understanding the concept and confidence or misconception. The result showed that understanding the concept of chemical bonds was very low at 25.6% and misconception at 67.80% in the high category for the control group. Meanwhile, the data for the experimental group showed that understanding concepts is high at 70.80 % and misconception at 25.90% is a low category. This study supports using the 3MV module significantly to improve conceptual understanding and reduce misconceptions about chemical bonding.

Keywords: Chemical bonding, 3MV module, conceptual understanding

Implementation of 4C Elements in Online Project-Based Learning to Assist Students' Communication Skills and Problem-Solving Skills for Biology Subjects

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This study was carried out qualitatively on Project Learning through the application of 4C elements, which are communication, collaboration, creativity and critical online can help students' communication skills and problem-solving skills for the subject of Biology among upper secondary students in secondary schools in Kota Kinabalu, Sabah. The first objective of this study is to identify the problems upper secondary students face when implementing Project Based Learning. Analytical research was conducted to identify problems through observation, document analysis, and interviews with seven students involved in project-based learning. The study's second objective is to test the initial theory using the 3P model through observation, interview and document analysis. The third objective of the study is to refine findings or theories implemented through interviews, observations and document analysis. This study is a qualitative case study that aims to gain a deeper understanding of online Project-based Learning. All data obtained through interviews, observations and document analysis were analysed using triangulation techniques. This finding concludes that there is a need to apply 4C elements in online Project-Based Learning for Biology Subjects. The first objective findings show that students need help with cooperation, teacher guidance, and question-and-answer sessions when implementing project-based learning, using different languages, speaking opportunities, and time constraints. The second objective findings show that students need to be allowed to say. PBL is implemented in groups through a systematic task distribution system. The teacher acts as a facilitator; the teacher needs a set of meaningful questions to encourage students to learn by inquiry, and students are given time to implement PBL. There is also the need for argumentation or dialogue techniques through presentation techniques and a systematic scoring system. Overall, it shows that students are satisfied with implementing project-based learning online through applying 4C elements to help students improve their communication and problem-solving skills in biology.

Keywords: Communication, problem-solving, biology, project-based learning

Involving Students in Developing Atom Model to Enhance their Understanding of the Atomic Structure: An Action Research Project

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In science class, models are routinely used to help students visualise a concept, object, process, or system that cannot be experienced directly. This action research aimed to enhance students' understanding of atomic structure by participating in making the model of atoms. The participants were 30 students of Form One in a secondary school in Penang, Malaysia. Quantitative data have been collected using pre-post-test and questionnaires. Qualitative data were gathered through observations and student feedback writing. The findings revealed that students improved their scores in the post-test and were more engaged in the atom model-making activity. As one form of active learning, students' hands-on activity encourages them to collaborate actively on tasks given, improving their understanding of learning. This action research is significant for teachers and students as it shows that applying hands-on activity could improve students' engagement in learning activities.

Keywords: Science learning, developing models, atom structure model, hands-on activity

Kit Subadd Vismat Application Innovation: A Simple and Fun Way to Learn Addition and Subtraction

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This study sought to introduce the KIT SubAdd VisMat innovation, designed to help students learn the concept of addition and subtraction correctly. The key objective of this innovation is to assist pupils in comprehending the concept of addition and subtraction, notably regrouping, and foster a passion and enthusiasm for Mathematics via engaging learning. The innovation that applies this KIT SubAdd VisMat uses learning aids, sample images and digital materials. The study involved 90 seven-year-old students in three selected elementary schools in northern Malaysia. The pupils were categorised into three groups: the control group, the module group and the applications group. The control group was taught using the conventional method, whereas the module and applications group used KIT SubAdd VisMat. The findings revealed a statistically significant difference in score mean between the module and control group, as well as the applications and control groups. Module group and apps group students had a better understanding of addition and subtraction concepts, especially when it involved regrouping. The findings of this innovative research provided a simple and entertaining explanation of mathematics concepts.

Keywords: KIT SubAdd VisMat, addition, subtraction, mathematics, regrouping, digital materials

Mastering Differentiation: A Hands-On Approach

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Secondary school students often need help solving differentiation problems and need help to relate this topic to real-life situations. Differentiation is one of the essential but challenging concepts in calculus. A hands-on approach with a STEM module has been developed and implemented among Form Five (Grade 11) students from SMJK Chung Hwa Confucian in Penang to address this issue. Pre- and post-test questions were administered to assess the student's understanding of maximum and minimum points. During the hands-on approach, students solved a real-life problem by determining the minimum area using a heuristic method and constructing a model. They then justified the volume of their model. Geogebra software was employed to aid in comprehending the turning points of the equation. Students eagerly presented their constructed models in groups, explaining their work and making conjectures. The results of the post-test indicate that 16 out of 30 students could answer a Higher Order Thinking Skills (HOTs) question-related to the concept of maximum and minimum values without the guidance of a teacher. Furthermore, the hands-on approach actively engages students in teaching and learning, bridging the gap between calculus concepts and real-life situations. Students gain a deeper understanding of the concept by relating and solving problems involving maximum and minimum values within real-life contexts, ultimately leading to improved performance in school and national examinations.

Keywords: Differentiation, hands-on-approach, geogebra, calculus,

A Phenomenological Study of Teachers' Professional Learning and Their Understanding of Making Meaning in Mathematics

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Meaningful teaching and learning of mathematical concepts project provided professional development for Year 3 to Grade 8 mathematics teachers in a district in the Eastern Cape province of South Africa. By the end of this programme, teachers were interviewed to understand their perception of what they learned in terms of making meaning in mathematics. This article describes the professional development programme and preliminary findings from the analysis of the interviews with three teachers who participated in the project for three consecutive years. By understanding teachers' perceptions in this case, this article informs future professional development programmes aimed at improving teachers' knowledge and making meaning in mathematics. Findings indicated that teachers learnt how to improvise in the contexts using available artefacts as resources that promote understanding of mathematical concepts, lesson study practice and inquiry-based teaching.

Keywords: Mathematics, meaning, professional learning, artefacts, lesson study

Ethnomathematical Practices in Tahiti (*Thysanolaena Latifolia)* Farming: Integration for a Localised and Authentic Mathematics Curriculum

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The study centres on the Indigenous Tahiti farming practices of the Obo Manobo community of barangay Manobisa, Magpet, North Cotabato. Using an ethnomathematical lens, I attempted to understand the community's knowledge and its connections to the basic education mathematics curriculum. Ethnographic participant observation and community immersion were employed, and data was gathered through interviews and field notes. Narrative research analysis through second-generation didactical engineering was utilised to make sense of the data gathered. Findings revealed that the small-scale farmers of Tahiti use the following ethnomathematical practices: (a) using dupa in measuring the distance between planted Tahiti clumps, (b) abre puno, (c) abre kalsada, (d) proportioning of harvested tahiti stalks (inupat, linima, tersya, and tunga), (e) measurement that uses body parts, (f) soft broom production, and (g) accounting of finished soft brooms. These practices were connected with ten learning competencies of the K to 12 junior high school mathematics curricula. Across these competencies are the concepts of measurement, estimation, perimeter, circumference, ratio and proportion, inverse proportion, and counting principle. These ethnomathematical practices will greatly contextualise and localise mathematics curricula, further making mathematics teaching more relevant. Mathematical tasks or problems were designed, and their integration into the curriculum was discussed with math teachers from nearby schools. The research findings provide insights into the benefits of integrating ethnomathematics into mathematics education and shed light on how these practices might enhance students' mathematical understanding and application. The implications of this study concerning representing indigenous knowledge in the curriculum will be discussed.

Keywords: Ethnomathematics, Indigenous knowledge, contextualised mathematics curriculum

Mathematical Investigation in HyFlex Setup: Affordances and Constraints for Engineering Students' Participation

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This paper aims to investigate the value of incorporating mathematical investigation (MI) in a Mathematics course for engineering students and to identify the affordances and constraints in a Hybrid-Flexible (HyFlex) setup, specifically focusing on structuring students' participation in MI activities. This qualitative study involved 27 chosen engineering students exposed to MI within a HyFlex learning modality. Data was collected through students' written outputs, oral presentations, and video reflections. Thematic analysis was employed to analyse the gathered data. The findings revealed several key aspects of the value and challenges related to MI in the HyFlex setup. Firstly, MI in HyFlex allowed students a more engaging and immersive learning experience. Secondly, the HyFlex environment offered students the flexibility to choose their participation mode, allowing students who are sick or away from school to perform activities still remotely. Thirdly, technological constraints affected students' ability to fully participate and collaborate with their classmates in certain aspects of the MI. Lastly, while the HyFlex model provided flexibility, students needed to manage their time effectively to optimise in-person and remote engagement in MI tasks. The value of MI in a HyFlex setup can help mathematics educators design more effective and inclusive learning experiences. The insights into affordances and constraints provide valuable guidance for structuring and optimising participation in MI activities. Addressing technological challenges and emphasising time management strategies can further amplify the educational impact of HyFlex environments for engineering students.

Keywords: Mathematical investigation, mathematics teaching, hybrid-flexible learning, thematic analysis

Numberless Word Problem Strategy in Sentence-Based Mathematics Problem-Solving Skills among Year 5 Pupils

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This action research was conducted to determine the type of mistakes made by year five pupils in solving mathematics word problems and to determine student performance before and after the Numberless Word Problem Strategy was implemented in their classroom. This is a qualitative study using Somekh (1989) action research design. The research sample was chosen using purposive sampling techniques involving three year-five pupils from rural areas in Semporna, Sabah. The data collection was done in two weeks, involving three intervention sessions. The research instruments used were document analysis, pre and post-written tests and interviews. Data analysis was done qualitatively; the pupil's mistakes were categorised based on the Newman Error Analysis Model. Change in pupil performance was measured by the number of mistakes made in pre and post-written tests and interviews. Findings triangulated their comprehension. Research indicates that pupils at band three-level (TP3) in mathematics often make mistakes at the comprehension level. Meanwhile, pupils at the band four level (TP4) often make mistakes at the transformation level. Results also indicate that the Numberless Word Problem Strategy had effectively reduced the number of errors made at the comprehension level during post-written tests. This research offers an alternative teaching strategy for teachers, especially lessons involving mathematics word problems, and as a stepping stone to conduct experimental research on a broader scale.

Keywords: Mathematics word problems, student performance, Newman Error Analysis Model

The Relationship Between Level of Metacognitive Skills Towards Achievement of Mathematical Problem-solving in Primary School

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Mathematics requires complex problem-solving skills. Since real-world issues are frequently non-routine, it is essential to introduce children to mathematical thinking exercises that entail problem-solving techniques. The level of metacognitive skills is closely related to the student's level of achievement in mathematical problem-solving. This study explores the relationship between the level of metacognitive skills and achievement towards mathematical problem-solving of primary school students. This study uses a quantitative survey approach on year five students at SJKC primary schools in Kuala Lumpur. A total of 366 respondents were randomly selected to participate and complete the questionnaire in this survey. The questionnaire consists of 20 questions about four aspects: awareness, cognitive strategy, planning, and self-checking. The data analysis used in this study was descriptive analysis, including the mean, standard deviation, frequency, and percentage. In contrast, Pearson's r correlation was used for the inferential analysis using the Statistical Package for Social Science (SPSS) version 27. The mean score's interpretations showed m=2.90 for the awareness aspect, m=2.78 for the cognitive strategy aspect, m=2.93 for the planning aspect, and m=2.90 for the checking element. These results indicated that the Year 5 students have moderate metacognitive skills. Furthermore, the results also showed a strong positive relationship between students' metacognitive skills and achievement in mathematical problem-solving. This study proves that students who exhibited higher levels of metacognitive skills demonstrated superior problem-solving abilities, leading to better academic performance. It is anticipated that education stakeholders will enable students to develop greater proficiency and confidence in problem-solving during primary school.

Keywords: Metacognitive skills, achievement, mathematical problem-solving, education

Mastering Division with MD'Teknik: Fueling Year Three Students' Math Enthusiasm and Academic Triumph

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Division considered the most difficult essential operation for primary school students, has contributed to placing Malaysia in the lower quartile in international mathematics assessments in terms of achievement, as proven after reviewing past studies. *Lembaga Peperiksaan* has suggested that students learn various mathematical problem-solving techniques. Therefore, this paper aims to present a newly developed mathematical problem-solving technique, MD'Teknik, on Year Three students' impacts on mathematical problem-solving. This study uses a quasi-experimental design with a quantitative approach involving 60 students in a primary school in Seremban district, Negeri Sembilan. They were divided into 30 students in the control group and 30 in the treatment group. Pre-post test scores were analysed through independent t-tests and Pearson's Correlation using the Statistical Package for Social Science (SPSS) to answer research questions and hypotheses. The independent t-test shows the results of [$t58$ = -2.323, p= .024] while the results of Pearson's correlation show that [r = .449, p = .013]. These results indicated that MD'Teknik has significantly improved Year Three students' achievement in mathematical problem-solving compared to the conventional method. Besides, results also show that MD'Teknik has a moderate positive relationship with students' interest in mathematics. This study proved that MD'Teknik benefits education stakeholders and should serve as an alternative in mathematical problem-solving. In further studies, we hope this technique may be effective with other types of respondents, including incredibly inclusive Indigenous students.

Keywords: Division, MD'Teknik, achievement, interest, education stakeholders

Science and Maths in the VUCA World: A Comparative Insight into the UK Professional Standards Framework (UKPSF) and the Kerangka Kompetensi Guru Bidang STEM (KKGB STEM)

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This research aimed to comprehend the role of the UK Professional Standards Framework (UKPSF) and the Kerangka Kompetensi Guru Bidang STEM (KKGB STEM) in bolstering educators to navigate the challenges posed by a world characterised by Volatility, Uncertainty, Complexity, and Ambiguity (VUCA). A comparative analysis was employed to assess how these frameworks support educators. The study specifically looked into the qualitative facets of higher education teaching promoted by the UKPSF and the emphasis of the KKGB STEM on digital literacy, real-life inquiry, and interdisciplinary integration in STEM pedagogy. The UKPSF encourages a culture of continuous reflective practice, fostering adaptability among educators. This is further evidenced by the HEA Fellowship, which recognises educators' professional development and urges them to remain updated. In contrast, the KKGB STEM primarily addresses the imperatives of science and math education for the 21st century. Key aspects include digital literacy in an evolving digital era and an emphasis on real-world inquiries, resonating with the VUCA nature. Furthermore, the interdisciplinary approach of STEM pedagogy fosters versatile thinking among students. Both frameworks are paramount for the contemporary educational landscape. While the UKPSF cultivates adaptability and continuous professional growth in educators, the KKGD STEM equips them with specific tools and strategies to meet the demands of modern science and math education. Collectively, both frameworks can complement each other in providing a holistic approach to nurturing educators proficient in leading students through the challenges of the VUCA world.

Keywords: UK Professional Standards Framework (UKPSF), Kerangka Kompetensi Guru Bidang STEM (KKGB STEM), digital literacy, continuous reflective practice, comparative analysis

Monitoring/Evaluating Tool(s) Development for Lifelong Skills-Enhancement e-Programmes as Exemplars to Sustain Quality of Science and Mathematics Education in VUCA World

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Implementing lifelong education to develop 'Future Ready' learners in preparation for the Industrial Revolution (IR) era is the global governmental aspiration in collaboration with the industrial sectors. In response to the call for quality technology-enhance Science and Mathematics education in the VUCA world, SEAMEO RECSAM initiated the 'Learning Science and Mathematics Together' [LeSMaT (Borderless)] project-based programme under the Golden SEAMEO Basic Education and Student Networking involving blended-mode lifelong education. This article reports SEAMEO Inter- Centre Collaboration (ICC) Education 4.0 project initiative as an offshoot programme of LeSMaT involving a mixed-research design study in 'Science, Technology, Reading, Engineering, Arts and Mathematics' (STREAM) demonstrating various models of skills under LeSMaT's sub-themes. These sub-themes are the guiding focus for project teams to develop technology-enhanced learning (TEL) output that could showcase their enhanced knowledge/skills required for their potential career employability. Literature research was done on existing e-programmes fulfilling SEAMEO's priorities, including discussions on developing an e-survey for tracking RECSAM's e-programmes in line with Sustainable Development Goals (SDGs). Qualitative and quantitative data collection and analysis methods were implemented involving a case study and validation of an e-survey entitled 'Motivation towards STREAM education' (MoToS). The qualitative analysis integrating 'type 4' multiple-case design includes analysing output illustrating curriculum innovation through transdisciplinary studies reflecting Education 4.0 and SDGs, whereas the quantitative method involved the Rasch model in validating MoToS to monitor/evaluate participants' engagement in the 1st Regional Workshop on SEAMEO-ICC Education 4.0. The findings using Rasch analysis revealed MoToS is reliable with a measure of CA 0.98 internal consistency, and 'feeling stressed on STREAM' is the most difficult item. After the e-course series 2020-2022, participants' output was examined using 'Cross-Case Analysis' (CCA) and 'Within/Exemplary-Case Analysis' (WCA/ECA). The e-course series produced SDG-related outputs with exemplars integrating SEAMEO Priority Areas No.7 and No.5. Future studies for Education 4.0 discussed include developing creative programmes to improve transdisciplinary quality education.

Keywords: Lifelong quality science and mathematics education, VUCA world, transdisciplinary studies

Augmented Reality as a Learning Media on Climate Change in Malaysia

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This study exemplifies the use of new technology with the potential to enhance the quality of education in Malaysia significantly. Additionally, it investigates the impact of implementing augmented reality as a learning tool on students' knowledge and technology usage in the learning process. The study focuses on the use of augmented reality as an educational tool for teaching the subject of climate change. The teaching instrument framework was designed using Fusion 360, SketchUp, Reality Composer, Virtual, and Eon-XR software. The study involved 25 second-grade students in the Kuala Selangor area. The results demonstrate that implementing augmented reality to identify climate change-related environmental issues has yielded positive outcomes. Students have displayed technological proficiency and a deeper understanding of climate change. Moreover, students have shown increased interest in learning and an enhanced ability to comprehend the subject matter. In conclusion, developing augmented reality as a learning medium can raise awareness and alter students' attitudes toward climate change.

Keywords: Augmented reality, learning media, climate change, EON-XR.

Lesson Study: The Tale of a Fair Game

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This paper reports the results of implementing an exploratory probability task. The study aimed to recognise students' knowledge in applying probability principles and properties in creating fair games and to draw the students' difficulties in creating fair games out of a pair of dice. By engaging in a Lesson study, the researchers carefully planned a task for a probability lesson, noted observations appertaining to the presentation and implementation of the task, and conducted a post-conference to reflect on these observations. Some results and recommendations are as follows: 1) Provide students with a task that will make them create and clarify misconceptions about probability, develop a strong sense of the properties of probability, and establish clear communication as the teacher elicits and scaffolds students' ideas about probability; and 2) Engage students in a game which provides an accessible environment for students to negotiate their issues and understanding of the concepts being introduced to them. In conclusion, setting up and implementing an exploratory task requires careful planning and provides opportunities for teachers to reflect on their teaching practices.

Keywords: Probability, fair game, lesson study, scaffold

Digital Teaching in Enhancing Effectiveness of Students' Learning

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Digital teaching revolutionises the conventional classroom model by transcending geographical limitations and granting students access to a global network of educators and peers. It encompasses numerous avenues for elevating student engagement, including interactive multimedia, online discourse, and adaptive learning platforms, enabling educators to craft vibrant virtual classrooms that accommodate diverse learning styles. Real-time feedback, gamified elements, and virtual simulations elevate interactivity and enthusiasm, promoting active involvement. This paper underscores digital teaching's potential for fostering international collaboration, uniting students worldwide for collaborative projects and discussions, enriching cultural appreciation, and equipping them with essential skills for a globally connected society. The study conducted at Politeknik Seberang Perai investigates students' perceptions of digital learning, identifies factors influencing their engagement, and explores potential correlations between teaching strategies and student engagement. Based on a random sample of 150 participants, the results empower educators to tailor their methods to individual student needs and inform the development of adaptive learning algorithms that accommodate diverse learning paces and preferences. In summary, digital teaching is a transformative educational force, offering innovative means to enhance the effectiveness of student learning.

Keywords: Digital teaching, interacting learning, student engagement, teaching strategies

Affective Factors on Malaysian Pre-service Science Teachers Readiness towards the Delivering of STEM Education

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Pre-service science teachers play a significant role in the development of human resources, especially in the science field, according to Malaysian Education Blueprint 2013-2025. Malaysia has targeted more scientists and engineers from the beginning of 2020 and needs to fill more than 236,000 manpower deficits in the STEM field. This is to make Malaysia a high-income country. This manpower needs to be prepared since their time in school. So, this paper investigates factors that influence pre-service science teachers' readiness to deliver STEM education approaches. Pre-service science teacher effectiveness in this study is defined as their professional beliefs and self-regulation. Their effective characteristics include STEM teaching efficacy beliefs, STEM teaching expectancy outcome and 21st-century attitude. The study was participated by 248 pre-service science teachers from teacher training institutes and public universities in Malaysia. A questionnaire set was given out, and the data obtained were analysed using SEM-PLS approaches. Analysis has shown that pre-service science teachers' STEM teaching efficacy beliefs and STEM teaching expectancy outcome were the main factors affecting their readiness towards delivering STEM education by 0.1 significant level on a 90% confidence level. This study suggests that pre-service teachers need to have high efficacy and high outcome expectations when delivering their teaching in the classroom by giving them a proper workshop or guidance during their study in their respective institutions.

Keywords: Pre-service science teachers, readiness, STEM teaching

Developing Water Level System Encouraging STEM Skills among Students

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The generalisation of vocations across subjects exacerbates the challenges in identifying the need for STEM skills in the labour force. Since there are several branches of science and engineering, and because these fields differ from one another throughout space and time, science and engineering are not professions in the traditional sense (Teitelbaum 2014). This study defines STEM Skills as problem-solving skills, mathematics, leadership, critical thinking, creativity, attention to detail and collaboration. However, we only discussed problem-solving skills and creativity for this paper. Learning will be meaningful due to the STEM education's goal of helping students relate science, technology, engineering, and mathematics to one another, other subjects, and real-world situations. In this project, students were exposed to water shortage problems in their school. To prevent the toilet from becoming dirty and smelly due to water shortage, the toilet should be closed automatically. Students need to develop a water level system that can overcome the problem; they use an engineering design process model. They were guided for eight weeks in developing their prototypes. Manova's analysis showed that creating a water level system can encourage STEM Skills among students. In addition to integrating science, technology, engineering, and mathematics subjects in STEM education, developing STEM skills is also very important.

Keywords: STEM skills, problem-solving skills, creativity skills and engineering designing process

From Virtual to Tangible: Enhancing STEM Teaching and Learning with 3D Printed Models

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Object-based learning involves using tangible models to facilitate hands-on experiences and more profound comprehension of abstract concepts. This study seeks to enhance STEM education by leveraging 3D printing technology to develop teaching materials promoting object-based STEM learning. The project's objectives are to design and develop a comprehensive library of 3D printable models aligned with primary science and mathematics curricula and to investigate the impact of object-based learning on student engagement, conceptual understanding, and academic achievement. The initial phase will involve mapping the existing curricula and learning objectives with relevant 3D print designs that represent complex concepts and accommodate different learning styles. A mixed-methods research approach will be used to evaluate the teaching materials' efficacy. Pre- and post-assessments, surveys, and interviews will be conducted to collect data on student learning outcomes, attitudes, and perceptions. The findings will be analysed to assess the impact of object-based learning on student achievement and motivation. The project will address scalability, cost-effectiveness, and teacher professional development challenges. This study advocates developing 3D-printed teaching materials to enhance object-based learning in primary school science and mathematics. By combining hands-on experiences with abstract concepts, this approach is hoped to improve student engagement, deepen conceptual understanding, and foster a passion for learning. Recommendations and guidelines for integrating 3D printing into existing science and mathematics curricula will be developed, along with teacher training programmes. As for the educators, it will equip them with practical tools and skills to inspire the next generation of STEM professionals.

Keywords: Object-based learning; 3D printing; science education, STEM education, teaching resources

Teacher Education Institute Students' Perspective on Adopting Mobile Learning in Science

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The study aims to determine the mobile device usage of teacher education institute students and their opinions on adopting mobile learning in science. A cross-sectional survey design was adopted in this study, and a questionnaire was administered to the students in the science department of a teacher education institute. A total of 54 students took part in this study. The quantitative data were descriptively analysed, whereas conventional content analysis was used to categorise and create emerging themes for the open-ended questions. The analysis showed that students in teacher education institutes conducted learning-related activities using their mobile devices. It included assessing science learning materials, conducting science online learning activities, watching science videos, and communicating with their lecturers or peers. They strongly agreed that mobile technologies facilitated personalisation in learning science and decided to use authenticity and collaboration for learning. They suggested integrating augmented and virtual reality applications to promote situatedness learning in science. The study implies that teacher education institute students are generally active mobile technology users. The outcomes of this study can be used by administrators and lecturers of teacher education institutes to promote the adoption of mobile learning in science according to students' learning habits and preferences.

Keywords: Mobile devices, mobile learning, mobile technologies, science, usage

Evaluation of STEM Makerspace Workshop using Kirkpatrick's Model

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Integrating the makerspace concept offers one way for educators to implement meaningful STEM project-based learning. Given that, a 3-day workshop entitled Introductory STEM Makerspace Workshop – learning through making was conducted for lower secondary science teachers focusing on electric circuits. In this workshop, teachers had the knowledge and skills to carry out maker-centred project-based learning in science. Besides, teachers were challenged to design and produce lessons incorporating maker-centred learning in the classroom or after-school activities. This study evaluated the effectiveness of this workshop for 18 teachers using three of the four levels of Kirkpatrick's Evaluation Model. The participants' reaction data was collected through the online evaluation form and observation during the workshop for level one. The results indicated that participants were positive for the workshop. In level two, the participants' learning was evaluated through photos and reflections uploaded in Google Docs after each session. They acquired the basic skills of soldering, 3D printing designs, and making a simple electrical product by applying the concept of parallel circuits. As for the third level involving behaviour change, the data was collected through voluntary feedback from the participants. Four participants indicated that they were applying their knowledge and skills in school at the time of writing. Thus, this evaluation determines whether and to what extent the workshop's effectiveness is for the participants. Additionally, it aids in identifying strengths and shortcomings and serves as a decision-making tool for future improvements.

Keywords: STEM maker space, teachers' training, evaluation, Kirkpatrick's Evaluation Model

From Classroom to Clean Energy: The MinUS-C Module's Impact on Solar PV Education

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This educational module aims to provide students with a genuine insight into the real-world context of solar PV concepts and technology. Innovative techniques bridge the knowledge gap, enabling students to embrace renewable energy technologies, particularly solar PV, through digital game-based collaborative learning and inquiry approaches. The immersive environment of the Minecraft digital game illustrates simulations of fundamental scientific concepts such as solar energy introduction, energy transformation, photovoltaic effects, circuit types, PV system components, and more. This stimulates students to apply newfound knowledge in developing a scientifically literate community using solar PV technology in real-life scenarios. Comprehensive assessment processes focus on the artefacts produced during activities and the students' experiential learning journey in constructing meaningful knowledge. This approach aligns with the aspirations of the Malaysian Ministry of Education to transition from conventional teaching methods to those that encourage active student engagement in the learning process. Furthermore, this module inspires students to explore potential career opportunities in the solar PV technology sector. With enhanced knowledge and readiness to adopt solar PV technology, students are poised to become change agents, aiding society in transitioning to renewable energy technologies, especially solar PV, ultimately achieving future energy sustainability goals.

Keywords: Solar PV Technology, digital game-based collaborative learning, inquiry approach, renewable energy technologies

The Quality of Teaching and Learning of the Lecturers on the Satisfaction Level of the Institute of Teacher Education's Students

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Student satisfaction is one of the main elements used to evaluate the effectiveness of courses related to computational thinking while teaching quality is considered an indicator of learning. This study aims to study the relationship between students' satisfaction towards the quality of teaching and learning (T & L) of the lecturers at the Penang Institute of Teacher Education. The study design is a survey, and the study sample is a purposive sampling where 34 students at the Institute of Teacher Education, Penang Campus, were selected as the study respondents. The research instrument used is a questionnaire adapted from Tang and Kong (2002) regarding quality T&L, which consists of dimension teaching, assessment, course, and guidance. The data is analysed using the Pearson Correlation. The study found that students' perception of T&L was at a high level, and students' satisfaction was also high. The inferential statistic showed a correlation between students' perception of the quality of T&L and their satisfaction. The learning process of using Scratch programming to instil computational thinking skills is seen as attractive, fun and satisfying to the students. The main implication of this study is that teaching and student involvement should be essential to ensure fun learning and problem-solving.

Keywords: Quality teaching, students' satisfaction, computational thinking

Goal Setting as a Metacognition Skill among Form Four Physics Students

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Goal setting is setting specific and achievable objectives within a defined period, considering personal strengths and limitations, and envisioning the desired result. To understand Physics concepts well, students need to have specific goals and be aware of their strengths and limitations. This study utilised the qualitative case study research design to investigate the goal-setting skills of Form Four physics students. The sample comprised six teachers, 16 students, and a public document. Data from students' and teachers' interviews and the Curriculum Standard Document and Assessments of Form Four Physics were triangulated to capture the goal-setting skills among the students comprehensively. The document and interviews were analysed using the six thematic analysis stages proposed by Braun and Clarke (2006). Based on the thematic analysis of the document, two categories were derived from the codes: 1) understanding the big picture and 2) valuing the task. Four categories were derived from the students' and teachers' interviews: 1) understanding their strengths, weaknesses, and learning profiles, 2) understanding the big picture, 3) valuing the task, and 4) recognising the attainable goals. The findings indicated that goal-setting skills were present among Form Four Physics students, and this skill can be further developed through additional studies.

Keywords: Goal setting, metacognition, physics students, thematic analysis

Impact of Brain-Based Teaching on the Conceptual Understanding of Newton's Law of Motion

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With the rise of several educational reforms, Brain-based teaching is deemed an effective teaching strategy as it focuses on how the brain could maximise learning. Following a mixed-method approach, this action research examines the impact of Brain-based teaching on the conceptual understanding of grade 8 students of Newton's Laws of Motion. Quantitative data were obtained using a concept test and worksheets, while qualitative data were gathered using a students' perception questionnaire (SPIQ), students' journals, and classroom observation. Quantitative results revealed significant differences between the pre-test and post-test scores, with a learning gain of 9.35 being the mean of the post-test scores. This implies that the learners have increased their understanding of the topic after the intervention. Daily worksheet scores also demonstrated a "very good" to "excellent" rating. Further, the SPIQ showed that most learners perceived BBT positively, with the highest mean score being 3.6. Finally, the journal entries highlighted three themes manifesting the merits of BBT in the classroom: enhanced learning through various activities, reflective learning, and insightful learning. These findings indicated that BBT effectively improved the learners' conceptual understanding.

Keywords: Brain-based teaching, relaxed alertness, orchestrated immersion, active processing, brain-based learning, Newton's Laws of motion

The Effectiveness of APOS-ACE Teaching Approach in Improving the Performance of Understanding and Application-Analysis in Differentiation Topics among Matriculation Students

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This study aims to investigate the effectiveness of the APOS-ACE approach in improving understanding performance and application analysis for the differentiation topic among matriculation students. The study participants included 96 students from Labuan Matriculation College and Malacca Matriculation College. This study used a quasi-experimental design that followed the non-equivalent control group design. Data that refers to score results was obtained from pre-test, post-test one and post-test two. The data was then analysed and performed descriptively and inferentially. The independent sample *t*-test reveals a significant difference in mean score marks between the students taught using the APOS-ACE and conventional approaches. Students using the APOS-ACE approach perform significantly better in Understanding and Application Analysis. They also exhibit a better retention of knowledge compared to traditional teaching approaches. It is recommended that special activities involving APOS-ACE teaching and learning be carried out to ensure better student performance in differentiation topics.

Keywords: Teaching approach, effectiveness, performance

Differentiated Learning: Utilisation of Alternative Methods to Assist Year Four Students in Mastering Multiplication Skill

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Multiplication operation is one of the fundamental skills in mathematics. This skill is crucial for elementary school students. If students do not master it, it will affect their learning and mastery of higher-level mathematical skills. Therefore, an action research study was conducted to assess the effectiveness of several alternative methods compared to the traditional algorithmic method in mastering multiplication skills. Initial assessments were conducted through student work reviews, pre-tests, surveys, interviews, and observations. The survey results indicated that students needed to be proficient in multiplication operations and grasp the concept of multiplication or the algorithm for solving multiplication problems. The alternative methods used in this study were Regrouping Multiplication (RM), Area Model Multiplication (AM), and Sticks Multiplication (SM). The study involved 26 fourth-grade students, 13 boys and 13 girls. Data were collected through Post-tests, student work reviews, surveys, and observations. The findings showed that 100% of the students in class 4M mastered multiplication skills using the alternative methods they chose, and a differentiated learning environment was successfully created among the students. The results of this study indicate that the introduced alternative methods are highly effective in helping students master multiplication skills and can assist teachers in establishing differentiated learning in the classroom.

Keywords: Multiplication operation, Regrouping Multiplication (RM), Area Model Multiplication (AM), Sticks Multiplication (SM), Differentiated Learning

STEAMing Ahead: Leveraging Graphing Technology to Foster Mathematical Thinking of Graphs of Functions

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This study explores an innovative approach combining Science, Technology, Engineering, Arts, and Mathematics (STEAM) with the study of graphs of functions. It narrows on the integration of mathematical software tools to facilitate the teaching and learning of graphs of functions by exploring and understanding the behaviour of functions. However, traditional methods of teaching these essential concepts often need to improve to foster creative and critical thinking skills among learners. Thus, the infusion of STEAM principles into the study of graphs of functions enabled the learners to create a learning environment that promotes mathematical proficiency and develops creative and critical thinking skills. Therefore, a preliminary study was conducted among 24 secondary school educators attending a Regular Course on Mathematics education at SEAMEO RECSAM. Questionnaires were analysed for the quantitative results, and semi-structured interview results were analysed for the qualitative data. The preliminary findings show that integrating STEAM principles into the teaching and learning graphs of functions is deemed suitable for a deep understanding of functions. It also indicates positive feedback to empower learners with well-rounded skills and essential knowledge to excel in STEM-related fields and beyond.

Keywords: STEAM, graphing technology, mathematical thinking

Tessellation on Transformation Geometry in Mathematics Classroom

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This paper aimed to present the structure of a tessellation teaching module for secondary school mathematics. The module used scaffolding theory through Vygotsky's Zone of Proximal Development as a theoretical framework. The researcher introduced tessellation through the scaffolding process by using selected examples of regular polygons, which involved transformation geometry such as reflection, rotation and translation, by showing suitable videos to the students for their better understanding of the tasks given. Group work of pupils in developing 21st-century skills such as communication, creativity, critical thinking and collaboration was carried out through cooperative learning to enhance knowledge sharing among the pupils. The module gave teachers a clear look into pupils' understanding of the transformation geometry. The group work helped the pupils consider and express their knowledge of the subject. The teaching module will provide secondary school mathematics teachers who want to introduce pupils to tessellation as a creative process and improve their understanding of transformation geometry; the teaching module will offer plenty of support and helpful suggestions.

Keywords: Tessellation, transformation geometry, teaching module

Ameliorating Lower Secondary Pupils' Mathematical Thinking and Ability through the Design and Development of a Mathematics Guidebook

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Lower secondary school pupils in Malaysia struggle to solve problems and make decisions using their mathematical knowledge and skills. The Trends in International Mathematics and Science Study (TIMSS) assessment since 2015 indicates that Malaysian secondary pupils' achievement was lower than the international average. As a result, this paper aimed to present a comprehensive design and development of a guidebook for teachers to supplement lower secondary mathematics lessons. The guidebook is based on the ADDIE instructional design model, namely using a model of analysing, designing, developing, implementing, and evaluating. This paper, however, is limited to two stages: design and development. Educators can use ten learning activities while teaching pupils in the classroom. The activities cover three interconnected major learning areas, namely "Number and Operations," "Measurement and Geometry," and "Relationship and Algebra." At the design stage, the guidebook involves mapping learning objectives, instructional strategies, and content structure. Meanwhile, the development stage consists of creating the content, developing the learning activities, and integrating the technology based on design specifications. Teachers' feedback and comments indicate a positive and encouraging hope that the guidebook will enable them to guide pupils to have better, deeper, and more meaningful mathematics learning. The guidebook can lessen pupils' mathematical thinking and ability through hands-on and mind-on activities.

Keywords: Mathematical thinking, teaching and learning, learning activities, mathematics

Safeguarding Intangible Cultural Heritage Through Game-based Learning Using Minecraft Digital Tool

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Minecraft is one of the most popular computer games that has caught the attention of educators all around the globe. It has a massive following from enthusiasts and has also been recommended as a helpful learning resource for student development. Technology is integral to teaching and student development in order to increase students' interest in different subjects and disciplines. This study shares the output of using Minecraft as a digital tool to safeguard intangible cultural heritage, as promoted by UNESCO, which is aligned with Sustainable Development Goals 11.4 proposed by the United Nations. The study's findings are within the expectation of the initiators, where the outcomes are seen as a positive, value-added activity to help reinforce students' learning and increase awareness towards heritage. Deeper insights into the student's opinions of the benefit were successfully attained. The results and findings will benefit educators implementing game-based learning to promote fun learning in 21st-century classrooms.

Keywords: Minecraft, Intangible Cultural Heritage, UNESCO

Empowering Educators: An International AI, Python and Robotics Bootcamp

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SMJK Keat Hwa, Malaysia, in collaboration with StemPedia from India, has organised a 2-week online International boot camp with the title of "Empowering Educators: An International AI, Python, and Robotics Bootcamp" for global educators from 23rd August to 2nd September 2023 to upgrade their knowledge and understanding of Artificial Intelligence, Machine Learning, Robotics, Python Programming, ChatGPT and Robotics with Python. Around 2000 educators from 18 countries joined the training camp, guided by Coding/STEM/Robotics Instructors or Trainers from around the world. We aim to help teachers and educators empower their classrooms with cutting-edge technology and innovative teaching methods. There were ten sessions during the boot camp, such as Introduction to Python, Game Development, ChatGPT, Human Body Detection, Introduction to Machine Learning, Hand Pose Classification, Face Detection, Natural Language Processing, Object Detection and Robotics with Python. A digital platform, namely PictoBlox, was being used. All ten sessions were conducted in real-time via live YouTube sessions with technical support via YouTube chat, WhatsApp, and Telegram. We help educators by empowering them with these digital and AI skills and providing recognition, prizes, and certificates internationally for free of cost. The top 10 performers were awarded Educational AI and Robotics Kits that help in learning and teaching 21st-century skills in a fun and engaging way. Pre-Survey and Post-Survey were conducted via a Google form. We wish to make extra efforts to bring change globally and increase the popularity of AI, programming, IoT and STEM.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), robotics, python, ChatGPT

Do Science Teachers Belief, Self-Efficacy and Attitude towards Exam-Oriented Practice Changed After the COVID-19 Pandemic: Challenges in Assessing Students in VUCA World

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The COVID-19 pandemic has changed the education system's scenarios, leading to the uncertainty of the future lockdown. Most nations cancelled or postponed face-to-face high-stakes examinations during the pandemic, and Malaysia is no exception. This creates agitation among education communities, primarily determining eligibility for higher education and how well the students have learned. This study investigates teachers' beliefs, self-efficacy and attitudes towards exam-oriented practice post-pandemic. A cross-sectional survey was conducted with a sample of 425 secondary school science teachers from five states in Malaysia representing the north, south, east, west and Borneo zones. Multiple Regression Analysis using the JAMOVI 2.3.28 version discovered that teachers' attitudes and self-efficacy significantly influenced teachers' exam-oriented practice by contributing 45.6% of the variance in teachers' exam-oriented practice. However, teachers' beliefs are not significant. A cumulative means from each construct shows that science teachers' beliefs, self-efficacy and attitudes towards exam-oriented practice are still high. Exam-oriented practice is still relevant among secondary school science teachers. Therefore, stakeholders need to consider the aspects of teachers' beliefs, self-efficacy, and attitudes in drafting policies before transforming new assessment systems to ensure not exam-driven education but holistically building the students' talents.

Keywords: Pandemic, exam-oriented, science teachers' belief

An Experiential Learning Approach to Develop Graduate Attributes

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This project aimed to evaluate the effectiveness of an experiential learning design approach in developing graduate attribute characteristics of student teachers in STEM subjects at a university in northern Malaysia. This project involved a collaborative design tool with three other universities in Scotland, the southern states of Malaysia, and Indonesia to assist university students in developing humanistic skills. This study was a quantitative research design with purposive sampling among third-year university students taking a science teaching method course. The graduate attributes used were communication, confidence, and critical thinking, and these skills were incorporated into lectures, tutorials, assignments and presentations. Paired-sample t-tests were conducted to assess the impact of the experiential learning approach on the three graduate attributes mentioned above. The results indicate statistically significant differences in the graduate communication, confidence, and critical thinking traits. This study has provided an assessment tool that can be used in teaching and learning to develop graduate attributes needed for employment after graduation. The study implies that some of the HEBAT elements addressed by the university can be integrated into the academic environment and not just extracurricular activities as is usually done.

Keywords: Communication, confidence, critical thinking, graduate attributes

Mathematics Teachers' Readiness in Information and Communication Technology (ICT) Implementation for Mathematics Teaching

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This paper aims to examine how mathematics teachers' readiness to implement ICT in the mathematics classroom. The method used is descriptive with quantitative and qualitative approaches. A questionnaire was given to six mathematics teachers, while interviews were conducted with three vice principal school leaders and two teachers. Both teachers and vice principals came from public high schools in Bandung, Indonesia, including SMA Negeri 8 Bandung, SMA Negeri 14 Bandung, and SMA Negeri 27 Bandung from January to June 2023. Quantitative data analysis uses a percentage system followed by determining readiness category, while qualitative data analysis uses the process of collection, reduction, appearance, and conclusion. The results of this study indicate that teachers are ready at the 'ready' level, which belongs to the second quartile from the top, with a percentage of 73.3%. Meanwhile, the interview results showed that the vice principals assessed that mathematics teachers were well prepared when asked to implement ICT-based learning. According to interviews, the teachers are already proficient in using ICT tools like PowerPoint or mathematical software like GeoGebra, Desmos, and Photo Math. This study gives information about teachers' readiness to utilise ICT learning as a resource for researchers who want to create ICT-based teaching materials so that we can judge whether schools have teachers who are and are not prepared.

Keywords: Mathematics teachers' readiness, ICT readiness, mathematics teaching

Titration Experimental Assessment using Digital Science Comic Book

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This study was conducted to identify the effectiveness of digital science comic books as a platform to explain how to perform "Titration" experiments for Chemistry subjects at the matriculation level of the Four Semester System programme. This study involves an action research approach. A total of 15 students were selected as a study sample in this action study. This study used a pre-test and a post-test to collect data. A pre-posttest was used to study student achievement improvement towards using digital science comic books. The results show that using digital science comic books positively impacts students. This study aims to identify the difference in scores before and after using this digital science comic book. The development started with the production of a module called "Module Critique" and continued with the digital science comic book production. It involves problem analysis, objectives, target users and content. This developed digital science comic book focuses on science-based content in Chemistry with teaching and education for the target users, which are the students in the Malaysia Matriculation system. This digital science comic book can be commercialised on various social media such as Instagram and Telegram. Apart from that, these digital comics can also be uploaded on websites such as blogs. Thus, integrating multimedia technology into education promises many opportunities for success. The advantages of digital science comic books as one medium in the world of education are that they have the potential to be studied and developed even though they are still new in Malaysia.

Keywords: Digital science comic book, titration, chemistry

The Effectiveness of Implementing the Multiple Intelligences Approach Enhancing the Malaysian Primary Students' Science Process Skills

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This study was undertaken to determine the effectiveness of multiple intelligence approaches in science teaching and learning to improve primary students' science process skills (SPS). The SPS consists of Basic Science Process Skills and Integrated Science Process Skills. The research design was a non-equivalent quasi-experimental control group design involving one group pre-test, post-test, and pre-experimental design. The study was conducted on a group of 64 students at a primary school in Penang. The instrument used in this research is the Science Process Skills (SPS) test. Descriptive quantitative analysis was employed on the findings, followed by subsequent inferential analysis using MANCOVA with repeated measures. The test result shows that the Multiple Intelligences Approach significantly improved Intelligence Orientation, Science Process Skills, and achievement among pupils. The study concludes that teaching and learning using multiple intelligences theory positively impacts the development of science process skills among students. The study's implication suggested that the multiple intelligence approach should be incorporated into teaching and learning science, specifically at the primary level. This is because children should develop from an early stage to learn science naturally based on their intelligence preferences.

Keywords: Multiple Intelligences, science process skills, teaching and learning

Demystifying Delusion and Unveiling the Crypt in Learning Science and Mathematics via the Dual Language Program

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The Dual-Language Programme (DLP) is advocated as it assists language proficiency development, promotes enjoyment, possesses positivity, elevates students' outcomes and academic achievement, and nurtures bilingualism. In Malaysia, DLP is the avenue for learning science and mathematics in English. Hence, this paper investigates students' understanding of DLP, readiness, acceptance towards the programme, and unearthing the challenges faced. A total of 2162 DLP students nationwide were involved using questionnaires, open-ended questions, and focus group discussions. Although they displayed a buoyant level in all dimensions measured, the respondents revealed several prominent issues and crucial challenges. These challenges need to be solidified in dire need. Otherwise, it may affect the progress of DLP. To recapitulate, DLP may succeed if the implementation is carried out well and its accountability is advocated by the interest group, particularly the students.

Keywords: Dual-Language Programme (DLP); science and mathematics; bilingual education; English as a second language

Development and Usability Testing For Augmented Reality Application, Carbon-Ary For Carbon Compound Topic in Chemistry Subject

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This research aimed to develop an Augmented Reality application, Carbon-ARy, consisting of the secondary school Chemistry topic of Carbon Compound as a teaching aid that can be utilised during Chemistry teaching and learning sessions. This research employed a developmental research design based on the ADDIE model. The respondents were selected for the Augmented Reality Application Carbon-ARy's Usability Testing through purposive sampling that was administered to five Chemistry teachers. The expert validation result obtained a coefficient value of 0.93 for the Content Validity Index, which was acceptable. The usability finding shows a high mean value in all six attributes that are evaluated: (i) compatibility between the teacher and the application (M = 70.0, SD = 35.4), (ii) design and display of the application (M = 71.0, SD = 30.2), (iii) the application interface's effectiveness (M = 80.0, SD = 16.3), (iv) reliability and content validity of the application (M = 100.0, SD = 0), (v) the application's ability as a learning aid (M = 96.6, SD = 8.1), and (vi) operation ability of the application (M = 86.6, SD = 20.6). In conclusion, this research successfully developed an augmented reality application, Carbon-ARy, that is valid and usable. The implications of this research successfully create an educational innovation, namely Augmented Reality, Carbon- ARy for Carbon Compound in Chemistry subject.

Keywords: Augmented reality application, chemistry, validity and usability

Assessing the Validity and Reliability of a Research Instrument for Measuring Science Literacy, Higher-order Thinking, and Student Achievement: A Comprehensive Analysis

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This study aimed to assess the quality and effectiveness of an achievement test designed to evaluate undergraduate mechanical engineering students' science literacy and higher-order thinking skills, which focused on material science and sustainability. This study was conducted at a higher education institution in northern Malaysia. The test consisted of multiple cognitive levels to gauge student proficiency. A pilot study involved purposive sampling of second-year undergraduate students who had previously enrolled in the material science course. Three subject matter experts tested the assessment test's validity, and reliability analysis was performed using data from eight students. The items in the achievement test were analysed and calculated to get the Content Validation Index (CVI), and the Kruder-Richardson coefficient (KR-20) was calculated via the Test Analysis Programme (TAP). The results show that while the research instrument was generally satisfactory, some refinements were needed, such as sentence structure and contents. This validation and reliability contributed to improved achievement of the test questions for future data collection, emphasising the importance of reliable data in subsequent research endeavours.

Keywords: Science literacy, higher-order thinking, validation, reliability

Advancing the Cultures of Science Teaching and Learning in South African Schools

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This paper reports on an outreach project to improve science teaching and learning in schools in South Africa. South African learners have consistently scored in the bottom part of all national and international benchmark testing in science and mathematics. The most recent TIMMS 2019 report again placed the quality of South Africa's mathematics and science education in a challenging position. This situation does not bode well for the country's human resource needs in the Science, Technology, Engineering and Mathematics (STEM) sector within the ambit of a 4th Industrial Revolution (4IR). This outreach project served to address this dilemma through three developmental stages, which incorporated (1) improving the culture of science teaching via inquiry-based pedagogy, (2) elevating the culture of science learning by cultivating learners' enthusiasm and interest in science, and (3) incubating the cultures of science teaching and learning in a creative space called a science teaching and learning centre. A multiple case study approach was used to carry out this qualitative research initiative, which sought to explore the impact of the outreach project on teachers and learners of participating schools. The study highlights several critical successes achieved, including (1) the application of an inquiry-based approach in science by the majority of teachers on the project, (2) learners' participation in science clubs and science competitions, and (3) the construction of 94 science laboratories at participating schools. The study identifies some key elements in its three-pronged development model that could prove crucial in planning future projects of this nature.

Keywords: Science education, Cultures of science teaching and learning, Inquiry-based science, Outreach project

The Forward-Backward and Dual-Panel Translation Methods are Comparable in Producing Semantic Equivalent Versions of a Computational Thinking Skills Questionnaire

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This study investigates semantic equivalence between two translated versions of the computational thinking skills (CTS) questionnaire produced by the forward-backwards and dual-panel methods. The forward-backwards and dual-panel versions of CTS were self-administered among 60 participants who met the inclusion criteria of being a native Bahasa Malaysia-speaking Malay, aged 14. The administration sequence of the two versions was randomised. Additionally, three sociolinguists, blinded to translation processes and survey findings, rated the translated versions against the source version on three aspects of semantic equivalence. The findings illustrate that textual content in both translated versions was considerably similar (n = 21/29, ≈ 72%). The overall results from weighted kappa, raw agreement, interclass correlations, Wilcoxon signed rank, and experts' ratings were confirmative of semantic equivalence between the forward-backwards and dual-panel versions of the CTS. However, some mixed findings indicated potential gaps in both translated versions against the source version. In conclusion, the forward-backwards and dual-panel methods produced semantically equivalent versions of CTS. However, translation alone is insufficient to narrow the subtle gaps caused by differences in culture and linguistic style.

Keywords: Computational thinking skills, lower secondary school students-reported outcome measures, surveys and questionnaires, translation

Validation of an Instrument for Measuring Malaysian Secondary School Students' Science Motivation and Self-regulation towards Science Learning

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Several studies have examined the students' motivation and self-regulation towards science learning among secondary school students. Students' motivation and self-regulation have been identified as influencing their engagement in science learning activities. Thus, there is a need for an instrument to measure secondary school students' science motivation and self-regulation towards science learning in the Malaysian context. This study aimed to validate an instrument for assessing Form Four students' science motivation and self-regulation towards science learning. A total of three (3) experts validated the instrument, which was adapted from the previous studies in measuring the students' motivation and self-regulation in science learning. Few changes were made to the instrument for the adaptation process based on the Malaysian context. The content validity index (CVI) was used to investigate the structure of the instrument's items after collecting the experts' responses. The instrument composed of four (4) constructs, including Learning Goal Orientation, Task Value, Self- Regulation and Self-Efficacy, corresponding to 31 items, was valid based on validity analysis with S-CVI/Ave of 0.96. Later, the newly validated instrument will undergo the reliability process after the pilot study to ensure the instruments' reliability before they can be used in actual experiments in the educational field.

Keywords: Science motivation, self-regulation, science learning, content validity index (CVI)

Exploring Project CREATE Mathematics and Peer-Assessed Gallery Walk in Teaching Mathematics

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The study aimed to evaluate the effectiveness of Project CREATE Mathematics combined with Peer-Assessed Gallery Walk in teaching Mathematics. The research followed a pretest-posttest control group experimental design. Two groups of thirty-eight and thirty-four grade 11 students were purposely selected, considering that sectioning in grade 11 is grouped heterogeneously. Before the lesson, both the experimental and control groups were given a pre-test. The experimental group was taught using the Project CREATE Mathematics and Peer-Assessed Gallery Walk, while the control group received instruction through the traditional chalkboard discussion method. After five weeks of exposure to the respective teaching methods, both groups were assessed with a post-test. The post-test results were compared to their pre-tests, and conclusions were drawn from the findings. The study showed that students' performance in both the control and experimental groups had improved, indicating the effectiveness of both teaching methods. Both groups demonstrated higher mean scores in the post-test compared to the pre-test, and their gain scores increased. However, the experimental group exhibited more significant gains than the control group. As a result, the Project CREATE Mathematics and Peer-Assessed Gallery Walk as a teaching strategy was more effective than the Traditional Method. The study's findings indicated that both the control and experimental groups demonstrated improved student performance, suggesting the effectiveness of both teaching methods. Moreover, the use of Project CREATE Mathematics and Peer-Assessed Gallery Walk as a teaching strategy for mathematics indicates its potential to enhance student performance. These findings can be valuable for educators, curriculum developers, and policymakers seeking evidence-based approaches to improve mathematics education.

Keywords: Project CREATE, peer-assessed gallery walk, mathematics teaching, students' performance, teaching strategy

Improving the Skills of Adding and Subtracting Length Measurements of Year 5 Arif Using Jo Double321 Method

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The innovation produced is JO Double321 for Mathematics subjects that focuses on adding and subtracting long measures that use column representation. This innovation is carried out to help students answer questions quickly without memorising many Mathematical formulas, in addition to creating an exciting and fun learning atmosphere. In addition, students can understand and solve the problem of addition and subtraction of length measurements through the modular approach, which combines two skills: conversion and addition of length measurements involving decimals with unit conversion. A total of eight students were involved in this study. JO Double321 can stimulate creative, critical and innovative thinking through elements of creativity that are carried out. This innovation also uses the visual space theory approach, which is that colourful number cards can attract the interest of weak students to learn with fun. The research design is quantitative, where the data is analysed descriptively using mean. Based on the mean analysis carried out in 4.7, it is said that this JO Double321 is very easy to use. The cost required is very reasonable as it needs readily available materials that can work every time for an extended period. Analysis of face-to-face teaching found that some students could reach Mastery Level 3 with repeated repetition and reinforcement. However, the findings obtained by using JODouble321 show that students can reach Mastery Level 3 with only one learning session. Implementing this innovation also positively impacts the effectiveness of student-centred teaching and learning, thus improving teachers' educational practices.

Keywords: Addition skills, subtraction skills, numbers

Analysing Mathematics Anxiety and Its Related Factors Using the DEMATEL Method

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This research aims to investigate math anxiety among Negeri Sembilan Matriculation College students and analyse the interdependencies and causal relationships among various factors contributing to this phenomenon using the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method. Math anxiety is a phenomenon that affects numerous students, leading to adverse emotional reactions and hindered performance in math-related tasks. A mixed-methods approach was employed, and the data was collected through a guided survey interview. A list of significant factors on math anxiety was presented from a thorough review of scholarly literature and expert opinions. Evaluation from a sample of six mathematics lecturers with extensive teaching experience where three of them are the subject matter experts (SME) and six college students grappling with math anxiety, was then analysed using the DEMATEL method to construct a cause-and-effect relationship matrix, quantifying the strength and direction of interrelation among these factors. The findings of this research have important implications for educational institutions, educators, and students alike. Firstly, the analysis highlighted specific factors that substantially impact math anxiety, such as previous math performance, teaching methods, and self-confidence. Furthermore, it uncovers the complex interdependencies among these factors, shedding light on how they mutually influence one another. Additionally, students will benefit from a more supportive and conducive learning environment that fosters self-confidence and effective study habits. These significant findings will contribute to evidence-based interventions and strategies to support students in overcoming math anxiety and achieving optimal math performance. It also contributed to the existing literature on math anxiety by offering a structured approach to assess and understand the relationships among contributing factors. This finding can inform educators, counsellors, and policymakers about the critical areas to target when addressing math anxiety.

Keywords: DEMATEL method, mathematics anxiety, mathematics performance, matriculation students, teaching methods

Application of Engineering Design Process (EDP) in Implementing Integrated PBL for Secondary School Students

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Implementing student-centred teaching provides more opportunities for students to learn actively. Several active learning methods are being practised today, one of which is Integrated Project Based Learning (Integrated PBL). The implementation of Integrated PBL in Malaysia is at an early stage, but it has become increasingly widespread. This study aimed to see how integrated PBL can be implemented by applying the Engineering Design Process (EDP). The steps in EDP, such as identifying the problem, exploring, designing, creating, testing, and improving, are seen to provide clear guidance to the students on how to solve the problems given in integrated PBL. The implementation of integrated PBL also considers the post-pandemic era and is carried out by applying technology. The study was conducted as an Action Study towards 161 Form 3 students from a secondary school in Melaka. The theme for the Integrated PBL in this study is Green Technology. The implementation has involved five subjects: Science (host), Mathematics, Engineering and Technology (RBT), Bahasa Melayu and English. This study followed the Kemmnis and McTaggart Action Study Model. Data for this study was collected qualitatively through observation, document analysis and open research questions to students. The findings of this study show that the implementation of Integrated PBL can be implemented well even though it involves a large group of students. The implementation of EDP has helped students collectively solve problems and produce Green Technology Home Models in structured ways. Students can also apply knowledge regarding green technology houses (Science), plans and elevations (Mathematics), mechatronic design (RBT) and writing and speaking in Bahasa Melayu and English in the same project. This study is expected to guide teachers keen to implement Integrated PBL in their schools and researchers in this field.

Keywords: Integrated PBL, Engineering Design Process, Post-Pandemic

STEAM Education: Understanding and Readiness among Malaysian Teacher Trainers

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This study investigates the levels of understanding and readiness for STEAM education among teacher trainers. This quantitative research involved 83 teacher trainers from Institut Pendidikan Guru Kampus Pendidikan Teknik (IPGKPT) selected using a random sampling technique. Data for the study were collected through the questionnaires. The data will be analysed in e. The findings indicate that the level of understanding among teacher trainers is moderate (mean=3.00, sd=0.58). Similarly, the level of readiness is also at a moderate level (mean=2.31, sd=0.85). The level of understanding in STEAM shows that the female teacher trainers are higher than the male. However, regarding the level of readiness, it shows that males are more ready than females. The results of this study highlight the need for teacher trainers to acquire additional knowledge and training, as well as a stronger intention to embrace and effectively implement STEAM education. These findings have significant theoretical and educational implications, which can inform the development of future instructional strategies and practices.

Keywords: STEAM education, teacher trainers

Project-Based Learning Strategies to Increase Student Creativity Skills in "Kurikulum Merdeka"

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Education and learning are student-centred, using practical learning approaches and optimising the use of technology. Therefore, prospective teachers' role determines the potential of the students they teach. This type of research is research into developing learning media in the form of electronic student activity sheets. In principle, development uses the R&D (Research and Development) development model. This research refers to the current development of the curriculum, which is an optional curriculum used by educational units, namely the independent curriculum with the achievement of Pancasila student character through project profiles using active and creative learning models. The learning media in the form of electronic student activity sheets is a category worthy of being assessed based on validity, effectiveness and practicality scores. The indicators of creative thinking ability achieved, namely sensitivity, fluency, flexibility, elaboration and originality in the control class, achieved higher indicators of creative thinking ability than in the non-student activity sheet and non-PjBL control classes. Using learning media in the form of student activity sheets developed and taught using the PjBL learning model can improve the creative thinking abilities of student teachers in creating learning media for students.

Keywords: PjBL, kurikulum Merdeka, student activity sheets, creative thinking skills

Authentic Learning in Urban Farming Fertigation Project to Enhance Students' Entrepreneur Mind

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Entrepreneurial thinking is critical in this VUCA world. Cultivating those thoughts needs to be done from junior high school to prepare them to be independent. The urban farming fertigation project allows students to identify environmental problems and how to overcome them to create a conducive and economic environment that utilises existing resources to the maximum. This study is a pre-experimental design involving two phases of vegetable cultivation intervention over one and a half years and supported by qualitative data. This study uses a purposive sample that involves 40 junior high school students and 10 teachers at a typical day school in the suburbs. The intervention involved cultivating two vegetables using a transdisciplinary STEM approach in fertigation technology. The research instrument consists of an entrepreneurial mindset questionnaire and an interview protocol. Repeated one-way ANOVA analysis shows that this fertigation project can enhance and sustain entrepreneurial thinking among students. Qualitative data analysis from student and teacher interviews supports quantitative analysis findings that strengthen students' entrepreneurial thinking. The implications of this project and study suggest that urban farming activities are intensified as a co-curricular activity to support learning in the classroom.

Keywords: Urban farming, authentic learning, STEM approach, entrepreneurial thinking

Aye, Aye, Captain! Let's Embark on an Engaging Virtual Math Learning Journey!

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Amidst the period of pandemic-induced confinement, there was a collective recognition of the pivotal function of internet platforms in affording pupils educational prospects. The primary focus of our research pertained to the challenges experienced in mathematics instruction, primarily in Graph Motions. More specifically, the researcher examined the issue of being unable to directly witness and monitor students' discussions during the teaching process. The main aim was to successfully include group learning within Google Meet sessions, prompting the teacher to devise innovative approaches for actively involving students on the platform. The researcher implemented the Jamboard software and breakout rooms to enhance collaborative learning, taking inspiration from a professional conference. The Jamboard programme facilitates synchronous collaboration on a communal digital whiteboard, promoting engaged involvement and an instructional strategy centred on the learner. Students can offer valuable insights, diverse viewpoints, and practical problem-solving approaches, fostering a culture of collaboration, effective communication, and the capacity to expand upon each other's ideas. The research encompassed 31 students from Form 5D at St. Cecilia Convent Secondary School in Sandakan, Sabah, Malaysia. Using the functionalities offered by the Google Meet platform, the researcher has successfully established an interactive and learner-focused educational atmosphere, departing from the limitations of conventional classrooms and facilitating active participation and cooperation within a digital context.

Keywords: Online platforms, Google Meet, Collaborative learning, Student-centred, Jamboard

Relationship between Constructive Feedback Practices by Appraisal Officers and Performance Appraisal Effectiveness

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This study aims to examine the relationship between the practice of giving constructive feedback by the appraising officer and the effectiveness of performance appraisal. The study's respondents are mathematics teachers in secondary schools in Sibu, Sarawak. Constructive feedback operationally refers to giving praise or appreciation to enable teachers to know the level of achievement of goals and targets that have been achieved, thus providing a stimulus to maintain good work performance. This cross-sectional survey study uses a questionnaire technique to collect research data, and the sampling technique used is a simple random sampling technique. The data obtained from 319 respondents show a positive and significant relationship between giving constructive feedback by performance evaluators and the effectiveness of performance evaluation in schools. Theoretically, this study contributes to developing the knowledge framework related to the studied variable, which is the practice of providing constructive feedback and the effectiveness of performance evaluation. From an empirical point of view, the study's findings provide evidence that explains the importance of readiness to provide feedback on work performance in the field of performance evaluation management, especially in relation to the field of education. From a practical aspect, the study's findings provide important information to various parties to formulate and improve policies related to human resource management.

Keywords: Constructive feedback, performance appraisal, cross-sectional survey study, evaluation management

From Blocks to Code: An Insight into Students Transitioning from Scratch to Java

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This research examines the transition from Scratch to Java programming, highlighting high achievement among participants. The study includes 21 students and utilises mixed methods, combining quantitative analysis and qualitative narratives. Findings demonstrate the effectiveness of Scratch Visual Teaching Aids (VTA) in developing educational games, understanding algorithm concepts, and improving programming projects. Students' attitudes towards Scratch VTA show increased interest, concentration, and enjoyment in learning. Qualitative narratives reveal varying perceptions of the transition, with prior programming knowledge influencing the shift. Challenges include adapting to the learning session and mastering Java's syntax and concepts. This study enhances programming education practices, providing recommendations for educators during the Scratch-to-Java transition.

Keywords: Programming, algorithm, Scratch, Java, visual teaching aid

Teachers' Self-Efficacy and Acceptance of Technology STEM Against Pedagogy Based on ICT in Schools with Less Students

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This study examined self-efficacy and teacher acceptance of technology in information and communication technology (ICT) based pedagogy for STEM subjects in underserved schools in Perak. A quantitative approach in the form of a survey study guides the study design. The study sample selection was done through a simple random sampling technique, where a total of 65 teachers in schools with few students and Perak covering teachers of STEM subjects provided feedback. The teachers involved in this study responded through three research instruments: the Teacher Sense of Efficacy Scale (TSES) instrument, the Initial Scale Items for Perceived Usefulness and Perceived Ease of Use instrument, and the instrument adapted from the Mailizar and Fan (2020) study. The data obtained were analysed through two methods: descriptive analysis and inferential analysis. Descriptive analysis found that all study constructs were high, with the most dominant value shown on the teacher self–efficacy construct (Mean = 3.58, SP = 0.22). Descriptive analysis also showed that teachers' acceptance of technology among the study sample was high, where the mean and standard deviation were (Mean = 3.55, SP = 0.17). At the same time, inferential analysis through correlation test showed a significant relationship between the variables of teacher self-efficacy and teacher acceptance of technology with ICT-based pedagogy, respectively, at a value of ($r = 0.623$, $p = 0.00$ at a significant value of $p < 0.01$) and ($r = 0.677$, $p = 0.031$ at a substantial value of $p < 0.05$). This study concludes that teachers 'self-efficacy and technology acceptance are significant predictors of information and communication technology (ICT) –based pedagogy.

*Keywords: S*elf-efficacy, teacher acceptance of technology

Advancing Technology Integration in Southeast Asian Education: Empowering Educators with Policy Insights

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The digital age has brought about a profound transformation in the education landscape, requiring educators in Southeast Asian nations to adeptly integrate technology into their teaching methodologies to prepare students for the future adequately. This research delves into the present status of technology integration among educators in this region and puts forth actionable recommendations to enhance their competencies. This study establishes a solid foundation for its findings based on an extensive e-survey conducted with 58,690 responses. The recommendations encompass augmenting accessibility to professional development initiatives, resources, and training to optimise technology integration. It also emphasises the creation of technology-rich learning environments and the cultivation of partnerships with technology organisations. This paper underscores the urgency of investing in the professional development of educators in Southeast Asia, with these recommendations targeting the provision of essential skills to equip students for an ever-evolving digital world. It particularly highlights the pivotal role of consistent policy implementation in ensuring the effective adoption of these recommendations. In sum, this paper furnishes valuable insights into the significance of technology integration among educators in Southeast Asia. It elucidates the essential measures to foster students' success in the digital era.

Keywords: Technology integration, educators, Southeast Asia, professional development, digital era, policy implementation.

Rise of Metaverse Literature in Asia-Pacific Countries: Bibliometric Study

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This research aims to explore past, present, and forecasted trends in Metaverse Literature within the Asia-Pacific region. The research leveraged a bibliometric method to extract 571 academic publications related to Metaverse Literature from the Web of Science database. The study then utilised co-citation and co-word analyses to ascertain the most impactful publications, understand the knowledge framework, and predict potential emerging trends in the field. Four primary clusters of influential works were identified through co-citation analysis, while the co-word analysis revealed three distinct clusters. The findings highlight the growing significance of Metaverse literature research in the Asia-Pacific region. While the importance of Metaverse Literature is evident in the Asia-Pacific region, there needs to be a more comprehensive examination of the research landscape. This study stands out as it shines light on the current research related to the metaverse and offers a unique perspective on the prospective future progression of the domain in the Asia-Pacific regions.

Keywords: Metaverse, Asia-Pacific, developing countries, bibliometric analysis, web of science

Digital Storytelling Science Creative Module

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The Digital Storytelling Creative Science Module, a groundbreaking solution, is designed to enhance students' creative thinking skills and achievement in science, specifically focusing on the Acid and Alkali topic. This pioneering module addresses a critical challenge: the enhancement of the three pivotal sub-skills of thinking—namely, association, visualisation, and divergent—among Form 2 students. Distinguished from traditional teaching methodologies, the PDSK Module employs an immersive storytelling approach, complemented by collaborative teamwork, to nurture these three essential creative thinking sub-skills. The classroom implementation of this module encompasses five progressive stages of digital storytelling, drawn from Cheng and Chuang (2019): Brainstorming, Dynamic Adaptation, Virtual Practice, Training, and Display. This innovative teaching methodology diverges from conventional approaches by adopting Merrill's first principles of instruction (2002), which spotlight the demonstrative facet to cultivate foundational student skills. The culmination of the five-tiered digital storytelling process within the PDSK module exhibits a remarkable augmentation in students' knowledge, application, and performance, translating into a tangible mastery escalation in the realm of science learning, mainly encompassing the intricate domain of Acid and Alkali.

Keywords: Digital storytelling, association, visualisation and divergent, acid and alkali topic