29th ATCM & 7th ISIMMED

ABSTRACT BOOK

The 29th Asian Technology Conference in Mathematics

a joint conference with

The 7th International Seminar on Innovation in Mathematics Education

YOGYAKARTA, INDONESIA

2024

A Joint Conference on Innovative Technology in Mathematics:
"Innovations in Mathematics and Mathematics Education Using Technology"

29th ATCM & 7th ISIMMED

Abstract Book

December 7-11, 2024,

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Contents

ABSTRACT FROM INVITED SPEAKER

Day 1. Sunday, December 8th, 2024

Invited Speech: Room 1★, (Chair: Keng Cheng Ang)

Topological Structures Between Two Closed Surfaces Inspired by An Entrance Exam Problem

Wei-Chi Yang, Weng Kin Ho, Guillermo Dávila

We shall explore with technological tools a problem we posed in [8], which originated from a college practice entrance question (see [3]). In this paper, we are investigating whether a certain closed surface-inspired by the aforementioned college exam problem and an a¢ ne transformation-is topologically equivalent to a sphere, utilizing the three- dimensional visualization capabilities of computer technology to aid our initial analysis. This technological affordance not only makes our investigation accessible to readers with just an undergraduate mathematics background but also allows us to study this surface in detail, finally leading us to a rigorous solution to the problem. Our work highlights the essential role that technology plays in advancing and communicating mathematical research.

Zoom Meeting ID for Room 1: 929 6060 9708
Passcode: atcm2024

Invited Speech by ISIMMED: Room 2, (Chair: Nur Insani)

Modeling spatial population dynamics using point pattern approach

Fugo Takasu

Various approaches have been proposed to study "spatial" population dynamics where we explicitly focus on spatial distribution of a population. Reaction-diffusion approach assuming a random diffusion of individuals is well-known and widely used. In my talk, I focus on an alternative approach of "point pattern" where we represent each individual as a point on continuous space. We assume that each point gives birth, dies, moves, and changes its status according to certain algorithmic rules. These rules can be translated to a set of mathematical equations that describe dynamics of point density (first order structure) and pair density displaced by a certain distance (2nd order structure). I introduce several examples about how non-spatial models given by ODE can be extended to point pattern dynamics models.

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Invited Speech: Room 1★, (Chair: Wei-Chi Yang)

Professional Development in Coding and Computational Thinking for Mathematics Teachers

Keng Cheng Ang, Marc Yi Fei Yeo

Since 2006, computational thinking (CT) has been popularised as a critical interdisciplinary skill and linked to mathematical thinking, solidifying its applicability in mathematics education. Singapore has actively introduced CT in its mathematics curriculum and provided professional development (PD) opportunities for mathematics teachers to develop their competencies in incorporating CT in mathematics classrooms. However, research examining how and whether such PD prepares educators to teach mathematics using CT is scarce. The study fills this gap by examining how a PD course that introduces the VBA coding language in Microsoft Excel for computational problem solving develops mathematics educators' coding skills and CT, and how participating in-service teachers perceive the course with regards to learning coding. Qualitative analysis of the course design revealed that the course materials are capable of helping learners develop CT through instilling in them certain coding habits, while qualitative and quantitative analysis of Likertscale and open-ended responses in the course feedback highlighted many strengths and suggested areas for improvement in various aspects of the course, like course structure, course materials, level of course difficulty, and perceived usefulness and applicability of the course. These findings reveal the benefits of computational approaches adopted in this study for developing CT and coding skills, the relevance of such approaches in mathematics education, areas that can potentially be improved for more effective PD, as well as how rich insights generated by feedback and course design analysis can contribute to assessing the impact of PD and tailoring PD courses to specific teacher needs and concerns.

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Invited Speech (**Virtual**): Room 2, (Chair: Vanda Santos)

Geometrical reasoning through open-ended tasks in a Dynamic Geometry Environment: An analysis through the theory of Variation

Jonaki Ghosh

Dynamic Geometry Environments have lent a new dimension to the teaching of proof in mathematics. Curricula across various countries have acknowledged the importance of the role of proof in school mathematics. The NCTM Principles and Standards (2000) states that students should be able to "make and investigate mathematical conjectures" and "develop and evaluate mathematical arguments". In a similar vein, the Position Paper on Teaching of Mathematics (NCF 2005) emphasizes the need for "systematic reasoning in mathematics" and articulates that the aim of teaching proof should be to enable students to "make and investigate conjectures and understand that there are various methods of reasoning".DGE affords the possibility to perform geometric constructions to a high degree of accuracy leading to empirical investigation of problems through experimentation and discovery. This has significant implications for enabling students to engage in conjecture making, systematic argumentation and to the teaching of proof. As Hanna (2002) points out, a DGE enables students to "easily test conjectures by exploring given properties of the constructions they have produced, or even 'discover' new properties." The primary feature of a DGE which distinguishes it from experiencing Euclidean Geometry in a paper-pencil environment is the ability to drag parts of a geometrical figure thus making it dynamic. The dragging feature is now recognized as a tool in itself and researchers have identified different dragging modalities using which a learner can engage in geometrical investigations. Leung (2008, 2012) distinguishes between different types of dragging – for exploration, for contrast and for confirmation. Referring to the theory of variation in learning, he maintains that "variation is the epistemic essence of the drag mode in DGE". The ability to make conjectures and discover properties of geometrical figures is made possible by the simultaneous interplay between the varying and the invariant in a dragging episode. According to him, one of the key purposes "in DGE dragging strategies is to discover invariant properties in the midst of varying components of a geometrical configuration." The impact of the variational theory, in particular of the four functions of variation, namely – contrast, separation, generalization and fusion, in DGE exploration and task design has attracted the attention of many researchers in the last few decades. In this talk we shall describe a study in which pre-service teachers with varied mathematical ability and limited exposure to DGE, attempted non-routine open ended geometrical tasks in a DGE environment. Their responses to the tasks in terms of empirical investigations, conjecture making, systematic argumentation and transitioning towards proof will be analyzed through the lens of the theory of variation. The findings of the study provide insight into the nature of tasks that are appropriate for a DGE environment, which can be "triggers" for proof and extends the notion of variation-invariant duality as a theoretical basis for DGE task design. Further, this approach also makes non-routine geometrical problems, usually not addressed in school mathematics, accessible to students. The study is merely a beginning attempt to extend the work done in the area of DGE task design via variational theory approach.

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Invited Speech (**Virtual**): Room 1, (Chair: Ma. Louise Antonette De Las Penas)
(Video)

Understanding Geometric Pattern and its Geometry Part 12 – Octagonal investigations

Miroslaw Majewski

This paper aims to show some basic examples of octagonal tessellations and patterns made with them. We will limit our investigations to a group of patterns with 90-degree intersections of lines. We will discuss the 'square side and diagonal' ratio and its use in architectural adornments.

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Day 2. Monday, December 9th, 2024

Invited Speech (**Virtual**): Room 1, (Chair: Wei-Chi Yang)
Cracking the Enigma Code: Beyond the Bombe
Adam Downs, Neil Sigmon, Rick Klima

The work of Allied codebreakers in the cryptanalysis of the Enigma cipher machine during World War II has been well-documented, and rightfully recognized as one of the supreme achievements of the human intellect. One of the trickiest parts of this analysis related to the plugboard, which contributed by far the largest factor to the total number of configurations of the entire machine. To determine the daily plugboard connections, codebreakers used electromechanical devices called the bombe and checking machine. After they found the plugboard connections though, they still needed to discover some additional machine settings. The difficulty in discovering these additional settings varied depending on which branch of the German military had created the messages under attack, since each branch used slightly different procedures. The process was in fact significantly more difficult for messages created by the German Navy, as opposed to those created by either the German Army or Air Force. In this paper, we will describe and demonstrate some of the procedures involved in recovering this additional information that was needed to fully cryptanalyze the Enigma machine. To assist in demonstrating these procedures, technology involving Maplets will be used.

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Invited Speech: Room 2, (Chair: José A. Vallejo)
Learning Experiences: Connecting A-Level Mathematics with Mathematics Used in The Real World via Machine Learning
Weng Kin Ho, Zhu Hui Joel Quek

One of the aims of the current Advanced Level H2 Mathematics Syllabus in Singapore is for students to connect ideas within mathematics and apply mathematics in the contexts of sciences, engineering and other related disciplines. A practising classroom teacher will find this very hard to achieve. On one hand, the mathematics that supports real scientific and engineering applications is often too sophisticated and lies beyond the reach of classroom mathematics -- at least as perceived by the teachers. On the other hand, textbook examples that bear some semblance of a real-life application often appear contrived. The teacher"s challenge is to find middle ground that caters for both accessibility and authenticity. This paper situates Gradient Descent, an elementary concept/technique commonly featured in Machine Learning, to create meaningful learning experiences with the aim of connecting topics within mathematics, and with the actual mathematics used to solve real world problems.

Zoom Meeting ID for Room 2: 917 6560 6395
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Invited Speech: Room 1, (Chair: Yuan Yuan)
Heptahedra each having a pair of parallel faces and their applications in Sangaku constructions
Jen-chung Chuan

Nathan Altshiller Court first studied a tetrahedron with all edges tangent to one single sphere, and coined the term "circumscriptible tetrahedron". Borrowing the idea, a polyhedron having all edges tangent to a midsphere is said to be circumscriptible. For a circumscriptible polyhedron, the circle formed by taking the intersection of a face with the midsphere is thus tangent to each edge of the face. Hence each face admits an incircle. A circumscriptible heptahedron is therefore associated with a family of 7 circles on the midsphere, with each circle tangent to 3 or more other circles of the family and the edges of the heptahedron are precisely the common tangents of the incircles

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Invited Speech: Room 2, (Chair: Alasdair McAndrew)
Development of a Question Distribution and Answer Collection System for Mathematics Classes Using Only One Line of Text
Setsuo Takato, Hideyo Makishita

KeTCindy and KetCindyJS are macro packages we developed for Cinderella, a dynamic geometry system. They allow the interactive creation of files of TeX figures and HTML. Since the pandemic began, we have been developing an LMS, KeTLMS, that can be used in online or blended classes. In mathematics classes, a major issue is how to communicate mathematical expressions. For teachers, it is easy to write them in TeX, but not so easy for students. They often take screenshots of their notebooks and submit them, which

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makes it difficult for teachers to grade them. In KeTLMS, questions and answers including mathematical formulas are exchanged as follows:

1. We have defined KeTMath rules, which make TeX math expressions easier. For example, fr(sin(x)+cos(x),x) means $\dfrac{\sin x+\cos x}{x}$ in TeX.

2. These formulas are instantly displayed on the HTML screen as two-dimensional formulas.

3. KeTMath keyboard is placed on the HTML screen.

4. Teachers create a text file of questions using KeTMath rules, and generate HTML of the questions using the Cinderella file named `toolketmathE.cdy". They distribute it via a platform such as Google Classroom.

5. Students answer the questions using KeTMath rules and submit them as a one-line text generated with the button `Rec".

6. Teachers collect students" answers, grade them, and communicate the results to students.

The text files are small in size and easy to process. For example, teachers can also easily create CSV files for table formats. KeTLMS can handle questions of various types, including not only standard questions that ask students to answer mathematical expressions, but also questions to prove an equation and post-class surveys.

Zoom Meeting ID for Room 2: 917 6560 6395
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Invited Speech: Room 1, (Chair: Jen-Chung Chuan)

Illustrating the Pre-Conjecture Phases of Experimental Research mediated by Dynamic Geometry: How Generalization Can Generate a Multitude of Highly Plausible Conjectures About Semi-Regular Polygons

Jean-Jacques Dahan

The origin of this work lies in the result concerning the area of the Steiner ellipse of a triangle: it asserts that the Steiner ellipse is the largest-area ellipse inscribed in a triangle. The first comprehensive proof of this result was provided by Minda and Phelps in 2008 ([5]). Finding their proof, which used complex numbers, not very geometric, I began an investigation using dynamic geometry. This led me to present an original proof, which, unfortunately, contained a part justified only experimentally ([6], [1']). Unable to find a formal proof for this part, I passed the task to my colleague Michel Carral, who found a purely geometric solution and asked me to present it in Prague ([8], [3']). Today, I decided to revisit the search for the missing proof from my 2019 attempt. This is the story of that work (see [3]). I show how my inability to prove the decrease of a complicated function on the interval [0, π/6] led me to reexamine the problem in various ways, generating, to my great surprise, unexpected results. This erratic search subsequently led me to explore a problem that generalizes the one that had been obstructing me. These new investigations proceeded methodically and systematically, producing both geometric and functional conjectures, will be detailed below. Although the proofs remain elusive, I discovered results that will be the focus of future research. This research journey perfectly illustrates the pre-conjecture phases of experimental research, as described in my 2005 thesis ([4]). It is worth noting that I have already demonstrated the crucial role of the generalization process in my article on tritangent conics ([9], [4']).

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Invited Speech: Room 2, (Chair: Vanda Santos)

The Development of Fraction Virtual Manipulatives and Their Applications to Low-achieving Elementary School Students

Yuan Yuan

The concept 0of fractions is fundamental, but students have consistently needed help to learn it. This study aims to develop a virtual fraction teaching aid (fraction virtual manipulatives) that can be used on tablets to assist students with difficulty learning fractions. This report will discuss low-achieving math students" challenges in using graphical representations to explain the meaning of fraction calculations. Then, the features of the developed digital tool will be discussed based on these challenges and applied in teaching low-achieving math students to explore its effectiveness. Finally, suggestions for teaching fractions will be provided.

Zoom Meeting ID for Room 2: 917 6560 6395
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Invited Speech: Room 1, (Chair: Jonaki Ghosh)
The Tangram: A Timeless Puzzle in Modern Education
Vanda Santos

The Tangram, a traditional seven-piece puzzle originating from China, has long captivated educators with its simplicity and complexity. Beyond its historical roots as a form of entertainment, the Tangram has found a significant place in modern education, leveraging its potential to enhance cognitive and spatial reasoning skills. This paper explores the integration of Tangrams in educational settings, highlighting their application in teaching mathematics, geometry, and fostering creativity. Additionally, it examines innovative approaches such as digital Tangram applications with Scratch. These advancements have redefined how Tangrams are utilized, making them more accessible and versatile for learners. The discussion underscores the Tangram''s enduring relevance as a tool that bridges traditional learning methods with contemporary technological innovations, ultimately promoting a more engaging and effective educational experience.

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Day 3. Tuesday, December 10th, 2024

Invited Speech Room 1: (Chair: Weng Kin Ho) (**Virtual**)
Calculus Is Everywhere: A Proof by Example
Douglas Meade

A common statement made by many calculus instructors is that calculus is useful in many real-world settings. Many of these same instructors then struggle to come up with examples other than area, volume, surface area, projectile motion, exponential growth, and logistic growth.
Twenty-six (26) new applications of calculus are included in "Calculus and Analytic Reasoning", a new calculus book by Sherman K. Stein and the presenter. Most Calculus Is Everywhere (CIE) sections are no more than three pages. Sixteen (16) of the book's 18 chapters have one or two CIEs, one has four CIEs, and one does not have a CIE.
Most of this presentation will focus on three CIEs, one from each semester of the traditional three-semester calculus sequence:
• Reflections on Reflections: Ellipses, Parabolas, and a Solar Cooker
(Chapter 4: The Derivative)
• Average Speed and Class Size
Chapter 8: Computing Antiderivatives)
• Newton's Law Implies Kepler's Three Laws
(Chapter 15: Derivatives and Integrals of Vector-Valued Functions)
The full list of CIEs in the textbook will be presented and shared.
I will be happy to talk about other CIEs as time permits in this talk, or in additional conversations at your convenience. I am also interested in suggestions for additional CIEs, particularly one for the chapter that does not presently have a CIE.

Zoom Meeting ID for Room 1: 929 6060 9708
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Invited Speech Room 2: (Chair: Jen-chung Chuan)
Automated generation of solved problems for self-study
José A. Vallejo

We study the possibility of generating step-by-step solutions to a certain class of problems, and its practical implementation with a CAS.

Zoom Meeting ID for Room 2: 917 6560 6395
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Invited Speech by ISIMMED: Room 1 (Chair: Ezra Putranda Setiawan)
Leveraging Machine Learning Algorithm to Uncover Insights into Student Performance: a Comparative Analysis of International and National Assessment Across Different Countries
Nur Insani

In the ever-evolving landscape of education, understanding student performance in mathematics has become a critical objective for educators, policymakers, and researchers. This talk explores how advanced machine learning algorithms can provide novel insights into student performance data from major international and national assessments such as PISA (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study). By leveraging classification and predictive modelling techniques, this presentation will uncover patterns in student achievement and identify key factors influencing performance across diverse educational contexts.

Throughout the session, we will delve into various machine learning methodologies—ranging from traditional algorithms like decision trees and support vector machines to more complex neural networks—applied to large-scale assessment datasets. The discussion will highlight the strengths and limitations of these approaches and demonstrate how they can inform data-driven decision-making in educational settings.

From the research outputs, we gain a comprehensive understanding of how machine learning can enhance the interpretation of assessment results, support targeted interventions, and ultimately contribute to improving mathematics education outcomes globally. This talk will provide actionable insights for educational researchers, data scientists, and practitioners interested in harnessing the power of data analytics to drive educational success.

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Day 4. Wednesday, December 11th, 2024

Invited Speech , Room 1 (Chair: José A. Vallejo)
Polynomials associated with bicentric polygons
Alasdair McAndrew

A "bicentric polygon" is one all of whose vertices lie on a circle (this makes it a cyclic polygon), and all of whose edges are tangential to another circle (this makes it a {tangential polygon). All triangles are bicentric---every triangle has a circumcircle and an incircle---but not all quadrilaterals are bicentric. Non-square rectangles, for example, are cyclic but not tangential, and any non-square rhombus is tangential without being cyclic. Bicentric polygons are also important to a result called "Poncelet"s Porism", or "Poncelet"s Closure Theorem", which says in effect that the circles corresponding to any bicentric polygon also correspond to an infinite number of other polyygons: indeed every point on the outer circle will be a vertex of some such polygon. Much work has gone into determining formulas connecting the radii of the two circles and the distance between their centres; this goes back to Euler and is still being actively investigated. As the number of sides of the polygon increases, the corresponding formulas grow in complexity. In this article we explore these formulas as polynomials in one variable, using computer algebra as our means of exploration.

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Invited Speech, Room 2 (Chair: Weng Kin HO)
Creating Planar k-isogonal Tilings
Ma. Louise Antonette De Las Penas, Mark Tomenes, Agatha Kristel Abila

This paper addresses the research problem of the characterization of a class of tilings or tessellations called k-isogonal tilings in the Euclidean and hyperbolic plane. Tilings that satisfy the property of having k transitivity classes or orbits of vertices under the action of their respective symmetry groups are called k-isogonal tilings. We contribute to answering the research problem by giving various constructions of k-isogonal tilings carried out with the aid of the dynamic geometry software GeoGebra.

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Invited Speech by **ISIMMED**   Room 2 (Chair: Nila Mareta Murdiyani)
Multimedia learning and Cognitive Load Theory: Current Research and Development
Endah Retnowati

Panel Session: Room 1 (Moderator: Alasdair McAndrew)
A.I. and Mathematics/Mathematics Education
José A. Vallejo, Russel Carlson, Alasdair McAndrew, Douglas Meade

Alasdair has an interest in academic integrity - student cheating - and will open a discussion about AI in this space. There have been various publications about AI as a potential for academic misconduct in teaching and learning; Alasdair will briefly discuss some of the recommendations so far published, and how they might be used in the context of mathematics teaching and learning.
José would like to discuss the effective use of AI in mathematics courses (specifically, homework). Students tend to accept any answer supplied by AI chatbots as correct, and very often that is not the case. So, this is a good opportunity to reflect on the importance of asking meaningful questions to avoid inaccurate answers, which requires some previous knowledge and a certain ability to think critically.
Russel has an interest in how AI works and how it can spark interest in areas in mathematics that are not often taught well; as well as what kinds of limitations AI has when trying to answer mathematics questions.
Douglas will look at some recently released AI-based tools for "doing" mathematics and welcomes discussion of what features we hope the future will provide (and avoid).
We hope these will be starting points for additional discussion with all attendees. What are your experiences with AI - both good and bad? What would you like to be able to do with AI?

ABSTRACT OF HANDS-ON WORKSHOP

Day 1. Sunday, December 8th, 2024

Computer Room 1,
KeTLMS Workshop
Yasuyuki Kubo, Setsuo Takato, Koji Nishiura, Hideyo Makishita, Chieko Komoda, Masumi Kameda, Masaki Suzuki

In mathematics classes, the main issue is how to send and receive mathematical expressions. KeTLMS is a system that can flexibly handle various questions and answers in remote, face-to-face, and blended classes, which is effective for teachers and students to communicate information that includes mathematical formulas. It has been developed with KeTCindy and KeTCindyJS, macro packages for a dynamic geometry system Cinderella, and CindyJS, a framework to create interactive mathematical content for the web. KeTCindyJS creates its own simple rules and can instantly display mathematical expressions written according to those rules as two-dimensional expressions. Thanks to this, even students who are not familiar with LaTeX can easily exchange complex mathematical expressions. By participating in this workshop, you will receive advice and be able to create various class materials. Participants should bring a laptop computer. Also, download "ketmath" to your laptop in advance from the following "GitHub" link (https://github.com/s-takato/ketmath). And please install Cinderella in advance. Cinderella can be downloaded for free from the link (https://beta.cinderella.de) introduced in KeTCindy Home.

Computer Room 2,
Introduction to SymPy for symbolic computing and geometry
Alasdair McAndrew

SymPy is a Python library for symbolic mathematics. As it is written in Python, it can be run anywhere that Python can – from computers, to tablets, even on mobile (cell) phones. (The presenter once spent much of an international flight working with SymPy on his phone.) SymPy is remarkably powerful and can manage calculus, algebra, and geometry with ease. Because it is a Python library, using SymPy means you also have access to the powerful Python ecosystem with its myriad of packages and libraries. (I have come to

use it more than Sage, simply because it's easier to install. To run Sage under Windows, you need to use the Linux subsystem WSL or something similar – there is no native Sage implementation for Windows.) This workshop aims to introduce participants to SymPy: some of its basics, and a few more-or-less advanced topics from calculus, algebra, and geometry. We will look at variables and functions, some of its numerical and graphics capabilities, and its geometry component.   Participants are welcome to suggest other topics. We will also explore the documentation, so that users can become experts! No previous knowledge of either Python or SymPy will be assumed. It will help greatly, though, if participants have already installed Python on their systems.

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Day 2. Monday, December 9th, 2024

Computer Room 1,
Desmos Artwork Workshop
Maria Digi Anna Mance-Avila, Maria Alva Aberin

Teaching graphs of equations and inequalities to students may be difficult without appropriate visual tools. To help teachers and students visualize graphs, a free online graphing calculator called Desmos can be used, as it allows its users to graph equations and inequalities, plot points, add sliders, and much more. These features make Desmos a useful tool for teachers as they teach graphing concepts and create interactive activities for their students. Likewise, students can create and explore various graphs independently or develop their own activities collaboratively. This workshop showcases how Desmos can be used to support the learning of graphs and promote creativity in a mathematics class by integrating students' knowledge of graphing and their love of the arts. By participating in this workshop, you will see sample artworks submitted by senior high school students and receive tips on how this activity can be used to help students visualize and understand graphs more clearly while tapping into their creative side. Participants should bring a laptop computer with internet connection. You may access the following links to explore sample Desmos artworks:
(https://www.desmos.com/calculator/99apvboe8b) and (https://www.desmos.com/calculator/48izadukqk)

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Computer Room 2,
Challenge facing mathematical experiments since 1995
Jen-chung Chuan

The First ATCM was held in 1995. Throughout the years the tools for mathematics experiments has undergone a great deal of changes due to the evolution of the technological environment. In this workshop, we attempt to re-experience the moments that made Mathematic Experiment exciting. We are facing the new environment offered by AI PC. Upon the first publication of Lotus 1-2-3, do we expect the excitement be lasting? Or, can AI PC last longer than Lotus 1-2-3?

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Day 3. Tuesday, December 10th, 2024

Computer Room 1
Leveraging "Asynchronish" Learning to Foster Belonging in Online Mathematics Education-
Dennis DeBay, Josie Smith

This conference presentation explores the innovative "asynchronish" approach to online mathematics education, blending synchronous and asynchronous elements to enhance student engagement and sense of belonging. Drawing from experiences in mathematics teacher education courses, we delve into how utilizing

collaborative platforms like Slack can transform the online learning experience. The session highlights strategies for creating dynamic, interactive environments that support both cognitive and social presence in mathematics instruction. Through examining practical applications and student feedback, participants will gain insights into designing online mathematics courses that promote active participation, peer collaboration, and a strong sense of community.

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Computer Room 2
TI-Nspire CX CAS Premium Teacher Software Workshop (Construct semi-regular polygons circumscribed to a given ellipse)
DAHAN Jean-Jacques

The software used during this workshop will be the computer version of the TI-Nspire CX CAS handheld. We will explore how to construct semi-regular polygons circumscribed around a given ellipse. Following that, we will investigate and attempt to conjecture the shapes of these polygons when they have either a maximum or minimum area. This workshop serves as an illustration of my invited paper. A semi-regular polygon is a polygon where the angle formed by two consecutive sides is constant.
Installation of the software:
https://education.ti.com/download/en/ed-tech/B993F3BD97D94D7EA35E5D514DD57FB5/9DEE626281C946ADB66887FAAC4B8115/TINspireCXPremiumTeacherSoftware-6.0.3.374.exe

Zoom Meeting ID for Room 2: 846 514 8866
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Computer Room 1
Understanding Different Topological Structures from a Layman's Point of View
Weng Kin Ho, Wei-Chi Yang

In this workshop, we will learn what topology is in Euclidean space, and why we should care about it from a layman's point of view. Starting with 2D structures, we proceed to consider some 3D surfaces which are inspired by certain transformations. We introduce basic topological concepts like continuous maps, homeomorphisms, and boundary points by appealing to 3D visualization features of computer technology and 3D printing. We hope to convince the participants that this way of learning topology is a lot more concrete and engaging, as compared to the usual abstract approach adopted by graduate textbooks. Participants will explore the 3D surfaces using Desmos from https://www.desmos.com/3d/lcr28pthtr or https://www.desmos.com/3d/pjtfo968gh.

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ABSTRACT FROM POSTER PRESENTER

SIS Point Pattern Dynamics with movements of points
Yumisa Kabe

Spatial dynamics can play a crucial role in epidemiology. Understanding how an infectious disease spreads over space is very important to control the disease. Partial differential equations (PDEs) are commonly used to explore spatial population dynamics. In this study, we explore spatial SIS dynamics in terms of "point pattern dynamics" where individuals are represented as points in continuous space and each point is either S (Susceptible) or I (Infectious). Hamada and Takasu 2019 [1] analyzed this point pattern SIS model where infection rate depends on the distance from infectious individuals. However, this model assumes that points do not move like plants. In our model, we allow points to move depending on its status S or I. Simulation results show that: 1) When Ss and Is move in the same way, the proportion of Is increases as they move over longer range or more frequently, and their spatial distribution exhibits complete spatial randomness. 2) When Ss move more frequently or over a longer distance than Is, i.e., points tend to stay in the same place when infected, Is tends to be spatially clustered and the overall point pattern also tends to be spatially clustered. 3) When Is move more frequently or over a longer distance than Ss, i.e., points tend to move

frequently or disperse over a longer distance when infected, Is tend to be spatially anti-clustered, and the overall point pattern also tends to be anti-clustered. We derive the dynamics of the singlet density and the pair density using the method of moments [2] which translates the individuals-based rules of infection, recovery, and movement of points to a set of integro-differential equations. We discuss how the simulation results can be interpreted in terms of the dynamics of the singlet and the pair density. Solving this integro-differential equations is a key issue.

[1] Hamada M., Takasu F., Equilibrium properties of the spatial SIS model as a point pattern dynamics - How is infection distributed over space?, Journal of Theoretical Biology 486 (2019), 12-26
[2] Dieckmann U., Law R. and Metz J.A.J., The Geometry of Ecological Interactions - Simplifying spatial complexity, Cambridge University Press (2000).

Empowering Rural Mathematics Education through the Mathematics Course Stack
Tang Jianlan, Qiu Wanli, Sun Jiayue, Huang Haiping

The Mathematics Course Stack at Guangxi Normal University is an integrated research and innovation center for pre-service and in-service mathematics teacher education in Central and Western China. It's a non-profit platform for crowdsourcing, co-creating, and sharing academic knowledge to serve society. Our team adheres to a philosophy of collective contribution and sharing, continuously optimizing over 2,000 sets of dynamic elementary and secondary mathematics teaching materials and micro-lessons. We have published five one-stop resources, collaborated with over 100 national alliance units to establish more than 200 practice bases, and recruited over 8,000 college students and frontline teachers. We've conducted over 300 charity events both online and offline, trained over 1,000 seed teachers nationwide through the "Lead Goose Project," and assisted over 40,000 rural mathematics teachers across 600 counties via the "Educational Charity Walk" and the "Young Teacher Program," providing them with training and resources. Our work has impacted over 30 provinces and direct-controlled municipalities, reaching over 20,000 schools and benefiting over 6 million teachers and students. This initiative has been recognized and encouraged by academicians such as Zhang Jingzhong, Tian Gang, and Zhang Weiping, and has been featured in over 40 media outlets including the Guangming Daily and People's Daily.

ABSTRACT FROM PARALLEL SPEAKER

Day 1. Sunday, December 8th, 2024

Session 1: 13:00-13:55

Room 3, (Chair: Warabhorn Preechaporn)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

(**Virtual**) (video) **Learning guidance based on analysis of symbolic comprehension**
Washino Tomohiro, Tadashi Takahashi

When two concepts contain a common concept, overgeneralization (the phenomenon of overgeneralizing specific rules or semantic features) may occur in the process of learners gaining an understanding of the two concepts in relation to each other. We use a neural network to analyze the overlap singularity phenomenon and the elimination singularity phenomenon in singular regions and perform simulations on the loss surface in previous research [4], [5]. In this study, the analysis technique "semantic comprehension" is applied to "symbolic comprehension". We defined four learning stages in the process of understanding of "permutations"and "combinations" and considered the simulation results regarding the change in training loss and the dynamics on the loss surface. Findings from this analysis are used to formulate learning guidance for teachers of mathematics.

[4] T. Washino and S. Ohashi: Learning guidance based on the overlap singularity phenomenon, Sci. Math. Japonicae, e-2023, No. 12, pp. 1-20 (2023)
[5] T. Washino and T. Takahashi: Learning guidance based on the elimination singularity phenomenon, Proceedings of 28th Asian Technology Conference in Mathematics(ATCM 2023), pp. 352-361 (2023)

(Virtual) Enhancing Computational Thinking Skills: Unplugged Activities and Coding for Mathematics Classroom

Warabhorn Preechaporn

Computational Thinking (CT) skills has been stated by Jeanette Wing (2006) as an essential skill for all and 21st Century way of solving problems. This article aimed to illustrate unplugged activities and coding to foster computational thinking basic skills. The activities will be applied for problem solving and better understanding of mathematics concepts. In this paper focused on the unplugged activities which conducted in the workshop such as Decomposition, Pattern Recognition, Abstraction, and Algorithm that can be applied for problem solving. Nevertheless, Scratch programming can be used for coding in teaching primary mathematics. The study was collaborated with primary mathematics teachers and to survey their perception of CT skills in mathematics classroom. The result provided that the CT skills can be used for problem solving in mathematics classrooms, which is essential to prepare future teachers and students on CT skills. It is necessary for students in the future because the students can apply CT skills for solving problems in daily life as well.

Room 4, (Chair: Mark Lester Garcia)
Zoon Meeting ID for Room 4: 955 6043 6058
Passcode: atcm2024

(Virtual) Development of a Specification Management System for Multidimensional PISA-like Mathematics Items

Mark Lester Garcia, Aldrich Ellis Asuncion, Catherine Vistro-Yu, et al.

This paper stems from the primary author's ongoing dissertation, which encountered a technological-logistical issue during the implementation of an item-writing study. The central problem discussed involves discrepancies between the table of specifications (TOS) for multidimensional PISA-like mathematics items created by teachers and the item specifications indicated in their individual item submission forms. These inconsistencies posed challenges in consolidating item specifications, impacting data collection and analysis (e.g., inaccurate alignment ratings due to mismatches between the TOS and item specifications). To resolve this, the authors developed an item specification management system in MS Excel, which automates processes like verifying incorrect entries and identifying unfulfilled constraints. Testing the system with hypothetical item specifications showed its ability to perform data validation, identify input errors, and detect entry conflicts; hence making it a viable and efficient alternative to the workflow used in the original study. These findings are significant for future studies replicating the primary author's dissertation, as the system mitigates potential issues in the manual input of item specifications, particularly for multidimensional PISA-like items with multiple dimensions such as item format, content category, context category, and process category. Such a specification management system can be very useful on a larger scale, as independent item-writing projects in educational institutions can utilize this without having to endure the use of several TOS's simultaneously which can inevitably cause confusion among the item-writers which makes the item specifications prone to manual errors; and without having to rely on commercially available item-banking software.

(Virtual) Integrating 3D Modelling into STEAM Education

Jozef Hvorecký, Vera Ferdiánová, Angelika Schmod, et al.

3D printers appear more and more frequently in all types of schools. To exploit them effectively, their educators have to become familiar with their appropriate application in their classes. The authors participate in an ERASMUS+ project which intends to assist future (pre-service) teachers to plan and carry out their future teaching activities with 3D modelling through a STEAM-based transdisciplinary approach. The main aim of our project is to design, to develop and to implement teaching approaches with 3D modelling. In order to follow contemporary trends in education, we promote the learning-to-learn approach by "learning to do" tasks enhancing creativity and production of 3D models. We are working on a MOOC to support both teacher training and school-based STEAM learning and to facilitate equal access to STEAM learning. In particular, we pay attention to specifics of partner countries' curricula and teacher training. The tasks and activities will address both in-class and online courses for future teachers, As our primary aim is to concentrate on transdisciplinary education, we will develop not only the activities. We will create a repository of high-quality teaching and learning resources as well as their evaluation criteria. In the future, the dissemination of project results is premeditated.

Common Fixed Point Results in Complex Valued b-Metric Spaces with Applications
Afrah Abdou

In this work, we obtain fixed point and common fixed point results for self mappings satisfying locally contractive condition in closed ball in the setting of complex valued metric spaces. To achieve our objective, we involve the control functions of two variable in the contractive conditions. As an application, we investigate that the existence of solution for Urysohn integral equations.

Connectivity Indices of Power Graphs over Dihedral Groups of a Certain Order
Arif Munandar

The dihedral group is a group built by symmetry and reflection elements. The representation of groups on graphs is intended as a bridge to understand groups more easily. One of the group representations on graphs is a power graph. The representation of groups on graphs in the form of power graphs is defined by considering all elements in the group as vertices, and two elements a and b are adjacent if there is a natural number n such that $a^n = b$ or $a = b^n$. By analyzing the patterns that appear on the graphs formed, connectivity indexes of power graphs over dihedral groups can be found, especially for order p^k with p prime numbers and k natural numbers. There are 6 connectivity indices investigated, namely the first Zagareb index, the second Zagareb index, the Wiener index, the hyper-Wiener index, the Harary index and the Szeged index.

Mathematical Model Of The Spread of Dengue Fever In Yogyakarta involving *Wolbachia* Mosquito
Fitriana Yuli Saptaningtyas; Hartono; Fithri Annisatun

Dengue Hemorrhagic Fever (DHF) is a highly contagious disease that can spread rapidly in tropical areas such as Indonesia, especially in the Special Region of Yogyakarta. Dengue fever sufferers can experience serious and even fatal complications if not treated quickly and appropriately. Data on dengue fever sufferers in the Special Region of Yogyakarta in 2023, namely 1,234 cases of dengue fever. This data shows that dengue fever is a significant health problem. Therefore, understanding how this disease spreads and how to prevent it is very important. Mathematically, the dynamics of the spread can be studied through mathematical modeling, both discrete and continuous models. The purpose of this study is to understand the spread of dengue fever mathematically in the Special Region of Yogyakarta by involving the influence of the Wolbachia mosquito. The specific purpose of the study is to obtain a comparison between the results of the discrete and continuous models and which model is most suitable. The model used is used to analyze the level of spread of dengue fever which affects important parameters so that it can be used to predict the occurrence of endemic dengue fever. The research steps are to develop and analyze discrete and continuous models of the spread of dengue fever in DIY involving Wolbachia mosquitoes, to predict how to control the spread of dengue fever so that it does not become endemic through a study of the existence of infected equilibrium points, parameter bifurcation, and numerical simulations.

Optimizing Development Recommendation Systems: A Case Study of Regional Clusters in Indonesia
Sri Andayani; Bambang SH Marwoto; Thesa AS Yusri; Fatma Agus Setyaningsih

This study aims to develop a recommendation system based on decision-making to improve regional development in Indonesia. The research integrates K-Means clustering and Multi-Attribute Group Decision Making (MAGDM) using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to rank 34 provinces in Indonesia. Data on development and crime indicators from each province are processed and normalized, then grouped using K-Means. Each cluster is further analyzed with TOPSIS to assess the performance of provinces based on relevant criteria, including the Human Development Index (HDI), Crime Index (CI), and Technology Development Index (TDI). Criteria weights are optimized using the Analytic Hierarchy Process (AHP), enabling final decisions to be more accurate and aligned with

developmental priorities. The findings reveal clusters of provinces with similar developmental characteristics, where provinces in economically advanced clusters have higher TOPSIS scores than others. These results provide a comprehensive perspective for policymakers to formulate effective, sustainable, and targeted regional development policies.

Room 7, (ISIMMED) (Chair: Nila Mareta Murdiyani)
Zoom Meeting ID for Room 7: 976 0547 7176
Passcode: atcm2024

How Students Strategize and Represent in Solving Early Algebra Problem? A Study on Functional Thinking in Primary School Students
Andi Sugianto; Rizky Rosjanuardi

This investigation endeavours to investigate the strategies and representations employed by primary school students in the process of generalising patterns.. The research design employed to accomplish the objectives of this study is a case study design that explores the functional thinking of students.. Data were collected from 16 students grade 5 primary school students through written tests related to generalizing pattern and interviews. Subsequent procedures involved interviewing 4 representative students to obtain comprehensive information regarding their responses to the written test. Students who used the recursive strategy focused on changing one quantity and could not make generalizations and students who used the correspondence strategy managed to build generalizations between pairs of corresponding variables and could use the generalization results appropriately. Students produce two categories of representations when generalizing a pattern. The majority of them employed verbal representation to represent the generalization, while the remainder employed pictorial representation. The research concludes that these distinctions are the result of their emphasis on pattern identification: students who observe recursive patterns are more likely to observe changes in a single variable, while correspondence patterns are associated with the corresponding pair of variables.

Enhancing Students' Mathematical Problem-Solving Skills Through a Problem-Based Learning Model within the Context of Education for Sustainable Development
Nazwa Syafira Gunawan; Erni Maidiyah; Elizar Elizar

Education for Sustainable Development (ESD) aims to empower learners with the knowledge, skills, values, and attitudes necessary to contribute to sustainable development. By integrating real-life issues into education, ESD promotes critical thinking, problem-solving, and decision-making skills, making it an effective approach for enhancing students' abilities in various subjects, including mathematics. The mathematical problem-solving skills of students in Indonesia are in need of improvement. To address this, a learning approach that enhances students' mathematical problem-solving skills through real-life contexts is crucial. The Problem-Based Learning (PBL) model within the framework of Education for Sustainable Development (ESD) is a significant tool in this regard. This study aims to evaluate the improvement of students' mathematical problem-solving skills through the PBL model in the context of ESD. The research is quantitative in nature, employing a pre-experimental design, specifically a one-group pretest-posttest format. The sample consisted of 32 Year 7 students, and the instrument used was a set of three mathematical problems. Hypothesis testing was conducted using a paired t-test, which revealed that learning with the PBL model in the context of ESD significantly improves the mathematical problem-solving skills of Year 7 students.

The Potential of the Interleaving Method in Mathematics Learning
Nila Mareta Murdiyani; Marsigit; Endah Retnowati; Ouhao Chen

One learning method that is in accordance with Cognitive Load Theory is the interleaving method, when each skill A learning activity is alternated with learning skill B, for example ABABAB. In this essay, related research (literature studies) is reviewed to support the reasons why the interleaving method can have the potential to have a positive effect in mathematics learning. The conclusion obtained that the interleaving method is useful in learning mathematics because it encourages discrimination, encourages associations, and encourages distributed practice (spacing effect).

Room 3, (Chair: Takuya Kitamoto)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

(Virtual) (video) Mathematical Modelling in a 3D Printing Project
Leyre Gilardi, Lucía Rotger-Garcia, Álvaro Nolla, et al.

This paper presents an experience in mathematical modeling conducted with master''s degree students in the Innovation in Education program, focusing on a project involving 3D modeling and printing. The project aimed to integrate hands-on mathematical activities into teacher training. The positive feedback from students and the mathematical competencies developed during the project support the inclusion of such activities in teacher education curricula. This study highlights the potential of 3D modeling and printing projects to enhance mathematical understanding and pedagogical skills among future educators.

(Virtual) E-Learning material creation system that utilizes existing teaching materials
Takuya Kitamoto, Masataka Kaneko, Takeo Noda, et al.

This paper describes a new framework for creating E-Learning materials. The new framework is intended for use by school teachers and can transform an existing teaching material into an E-Learning system utilizing HTML5 technology. The E-Learning system created is a web application consisting of a single HTML file, and can be used not only on PCs, but also on tablets and smartphones. The E-Learning system created with this framework features a two-layered screen structure: existing teaching materials are placed on the lower layer of the two-layered structure, and text boxes and buttons are added on the upper layer, allowing existing teaching materials to be converted to E-Learning systems. In addition, by incorporating Algebrite ([4]), a JavaScript library for symbolic computation, it is possible to perform symbolic computation of mathematical expressions and automatically grade students' answers. Since this paper is an extension of reference [3], we first briefly describe the contents of the reference. Then, after explaining the newly added functions, the flow of actually constructing an E-Learning system using this system will be explained step by step.

Room 5, (ISIMMED) (Chair:Siti Kholifah)
Zoom Meeting ID for Room 5: 943 3789 4785
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The Relationship between Quality of Understanding and Problem-Solving Ability in Mathematics Learning: A Systematic Literature Review
Fanni Yunita; Djamilah Bondan Widjajanti

The quality of understanding and problem-solving ability are important in mathematics learning. Quality understanding helps students to build more complex mathematical abilities. Meanwhile, mathematical problem-solving ability helps students gain experience, knowledge, and skills to overcome problems that they have in daily life. This research investigates the relationship between the quality of understanding and problem-solving ability in mathematics learning through a systematic literature review. The Systematic Literature Review (SLR) research method was used in this research. The data collection technique is carried out by documenting articles related to the topic. The results of the literature review showed that there was a relationship between the quality of understanding and problem-solving ability in mathematics learning. In mathematics learning, Students with the quality of instrumental understanding have a low to moderate level of problem-solving ability, and students with the quality of relational understanding have a high level of problem-solving ability.

The Influence Of Mathematics-Based Learning Multiple Intelligences In a Saintific Approach to Mathematical Literacy Ability, Learning Achievement, and Mathematical Disposition Student
Raden Muchammad Nurrizal Hasbi Ashshidiqqie, Djamilah Bondan Widjajanti

This research aims to (1) describe whether there is an influence of multiple intelligences-based mathematics learning in a scientific approach on mathematical literacy abilities, learning achievement and mathematical disposition; (2) describe which learning method is better in terms of mathematical literacy skills, learning achievement, and mathematical disposition. This type of research is quasi-experimental research. The

research subjects were class VIII B and class VIII C at MTs Miftahunnajah Yogyakarta to be given treatment. From these two classes, a draw was carried out and class VIII B was obtained as the control class which received mathematics learning using scientific learning methods and class VIII C as the experimental class, namely the class which received mathematics learning based on multiple intelligences in a scientific approach. The instruments used included a student mathematical disposition questionnaire. , a test of mathematical literacy skills and learning achievement. Validity is determined by the considerations of the validator who concludes that the instrument used in this research is valid. Meanwhile, estimates of the reliability of the mathematical literacy ability test, learning achievement test, and mathematical disposition questionnaire which were calculated using the alpha coefficient (Cronbach's Alpha) in this study were reliable. To see the effect of multiple intelligences-based mathematics learning in a scientific approach on students' mathematical literacy abilities, learning achievement and mathematical disposition, the Multivariate Analysis of Variance (MANOVA) statistical test was used. And to see which learning method is superior in terms of the average of each variable, the Independent Sample T-test statistical test is used. The results of the research using a significance level of 5% show that multiple intelligences-based mathematics learning in a scientific approach has an effect on student learning achievement, but has no effect on students' mathematical literacy abilities and mathematical disposition. In more detail, classes with a multiple intelligences approach are superior to classes without a multiple intelligences approach in terms of average learning achievement, however classes with a multiple intelligences approach are not superior to classes without a multiple intelligences approach in terms of the average literacy abilities and mathematical disposition of students.

Math Anxiety: What and How it Affects Student Conceptual Understanding and Mathematics Literacy

Khilmi Nada Imtiyaz; Djamilah Bondan Widjajanti; Siti Kholifah

Math anxiety is a condition associated with poor individual performance outcomes when dealing with anything related to mathematics. Various studies on the relationship between math anxiety and student learning outcomes have been conducted. However, studies examining the effect of anxiety on mathematical concept understanding and mathematical literacy are still limited. Therefore, this literature was compiled to further examine the phenomenon of mathematics anxiety and its effect on students' concept understanding and mathematical literacy skills using the literature study research method. The results obtained are that math anxiety is associated with poor individual performance when dealing with exams, a poor relationship with positive attitudes towards mathematics, and a direct correlation with avoidance of mathematics. Such attitudes can impact on the process of forming one's mathematical concepts. As a result, one's ability to apply mathematical principles in various real-world problems is less than optimal. In addition, concept understanding and mathematical literacy skills are interrelated so that if an individual's concept understanding is poor, it will also have a negative effect on his or her mathematical literacy skills.

Room 6, (ISIMMED) (Chair: Andika Putri Ratnasari)
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Modelling of Fighter Squadron Deployment System to Optimize the Covering of Indonesian Airspace with Set Covering Problem (SCP) Method and P-Median Problem (PMP) Methods

Salma El Mutafaqqiha Putri Achzabi; Gagat Riano

The system modelling is generally used to overcome the complex problems. This research is trying to mathematic model the placement of Indonesian Airforce fighting aircrafts such as F-16, SU 27/30, and Rafale/F-15 EX in order to cover the Indonesian territory optimally. The SCP method is used to determine the minimum number of squadrons required. Meanwhile, The PMP method is used to maximize the ability of covering the aircraft squadrons. The result of the modelling is that five air bases are needed to optimize the ability to cover the entire territory of Indonesian sovereignty. The difference between the results of the two methods is 674 km which shows a more effective and efficient system model.

Seemingly unrelated spatial regression modeling with earthquake case studies

Zhilvia Noviana Ningsih, Ahmad Fuadz Zainuddin

This study utilizes a Seemingly Unrelated Regression (SUR) framework to analyze earthquake data across multiple regions, focusing on the interplay between various seismic characteristics. By examining data on

magnitude, depth, frequency, and location, the SUR approach allows us to capture the spatial dependencies and correlations among these variables. Our analysis reveals significant relationships, indicating that seismic activities in one region can influence those in adjacent areas. Furthermore, the model identifies varying impacts of geological and environmental factors on earthquake occurrences, highlighting the non-homogeneous nature of seismic risks. This research emphasizes the necessity of incorporating spatial dynamics into seismic analysis, providing valuable insights for policymakers and disaster management professionals aimed at improving preparedness and mitigation strategies in earthquake-prone regions.

Does repeating a grade improve student achievement in Mathematics? Evidence from PISA 2022 in Indonesia

Kismiantini; Ezra Putranda Setiawan; Andika Putri Ratnasari

Repeating a grade has long been known in the Indonesian education system. Students might repeat a grade when they fail to achieve the minimum completion criteria of several subjects in an academic year. In this study, we explore the effect of repeating a grade on the mathematics achievement of senior secondary school students in Indonesia. We use a quantitative approach using secondary data, namely the PISA 2022 data provided by the Organization of Economic and Cultural Development (OECD). In Indonesia, the PISA 2022 survey was followed by 7,371 senior secondary school students from several provinces. We use two steps to analyze the data, namely (1) data validation, and (2) linear regression with plausible value in mathematics (PVMATH) as the dependent variable. The validation results showed that only 6,349 students gave valid answers, consisting of 5,619 grade 10 students, 235 grade 11 students, and four grade 12 students. Among these students, 38 had repeated a grade during elementary school, 15 during junior secondary school, and 12 during senior secondary school. We find that students who repeated a grade once in elementary school have significantly lower mathematics achievement than students who did not. At the junior and senior secondary school levels, there was no significant difference between the mathematics achievement of students who had repeated a grade and those who had never repeated a grade. Further intervention might be useful for students who repeated a grade in elementary school so that their mathematics achievement becomes similar to those who never repeated a grade.

The Role of Educational Robotics in Integrated STEM Learning Towards the Formation of 21st Century Skills

Nur Isnaini Hanifah

Local Culture-Based Concept Understanding Test Questions With The Assistance Of Sketchup: ADDIE Model

Meryani Lakapu; Yohanes Ovaritus Jagom; Aloysius Joakim Fernandez; Damaris Lalang

Cultural elements can be associated with mathematical concepts so that this study aims to produce good quality local culture-based concept understanding questions in this case valid, practical and effective questions. The test questions developed adjust to the local cultural context of Takpala-Alor. The development model used in this research is the ADDIE model which consists of 5 steps namely analysis, design, planning, implementation, and evaluation. The subjects in this study were first semester students in the Biology Education study program who temporarily took Basic Mathematics courses. The concept understanding questions that have been developed, then tested to see the validity, practicality and effectiveness. The results of validation by 2 experts showed that the questions developed met the criteria of very valid. The results of the evaluation of the trial class showed that the questions developed met the criteria of very practical and met the criteria of effectiveness. With the existence of local culture-based concept understanding problems, students find it easier to understand the problems presented in the problem then begin to determine the solution steps

Productive Failure Method Does Not Work For Novices in Learning Advanced Mathematics

Endah Retnowati; Djamilah Bondan Widjajanti; Endang Listyani; Husna 'Arifah

Productive failure is a learning method in which students are challenged with a novel problem solving task, hence they might create errorneous or uncertainty before are given feedback to evaluate their experience. This method was assumed could highly motivate students to learn beecause of the failure performance. This

study aims to describe whether there is a productive failure effect on students who were given a mathematics task on advanced level when the feedback is a worked example that are design according to the cognitive load theory. An experiment involving 89 university students majoring in mathematics was conducted by randomly assigned them into two experimental groups: productive failure versus conventional worked example pairs methods. Using the heat equation topic in the Differential Equation course, novel problem solvings were scheduled. Considering the prior knowledge test score as covariate, the results showed that students in the conventional method was significantly superior than the productive failure method in both retention and transfer tests that were administered immedietly after the learning phase. It seems likely that novices are not benefited by experiencing intended difficulty during learning.

Day 2. Monday, December 9th, 2024

Session 3: 08:30-09:25

Room 3, (Chair: Sepideh Stewart)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

(Virtual) Integrating Numerical Linear Algebra into a Proof-based Linear Algebra course using MATLAB
Sepideh Stewart, Mike Michailidis, Caleb Judkin

Linear algebra is a key topic in mathematics and is applied in many science and engineering fields. In this talk, we will explore the role of programming in enhancing linear algebra education. Specifically, we will investigate ways to bridge the gap between abstract and numerical linear algebra. We will report on a study about a proof-based second course in linear algebra encompassing various topics, including vector spaces, finite-dimensional vector spaces, linear maps, polynomials, inner product spaces, operators on inner product spaces, eigenvalues, and eigenvectors. There were 22 mathematics and engineering students enrolled in this course, and 15 students agreed to participate in this study. The course was redesigned to incorporate six labs and a final project using MATLAB to help students explore numerical linear algebra and its applications via programming. The instructor (first author) met weekly with a specialist from MathWorks (second author) and another support person to create the labs and give students help with MATLAB. We will present the analysis of students' feedback from the course exit survey and evaluate their performance in a lab involving the Power Method and Rayleigh Quotient to approximate eigenvectors and eigenvalues to gain insights into the effectiveness of this approach.

(Virtual) Digital Interactive Figures for Linear Algebra: Promoting Observation and Conjecture as Mathematical Activity
Ryan Peffer, Sepideh Stewart, Judi McDonald

Linear algebra is often positioned in university mathematics curriculum as student's first formally theoretical with an emphasis on proof. Furthermore, a standard obstacle in learning linear algebra is recognizing, organizing, and manipulating vectors and matrices. In this talk, we will present a series of digital interactive figures intended to help embody these abstract objects, as well as participate in a proto-formal mathematical culture of Observation, Conjecture, Proof, Theorem. We will discuss the design principles of interactive figures across a variety of linear algebra subjects, lessons learned from pilot deployments, and supplementary coursework to bridge the gap between observation and proof.

Room 5, (ISIMMED) (Chair: Siti Kholifah)
Zoom Meeting ID for Room 5: 943 3789 4785
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Apos Theory-Based Learning: Impact on Mathematical Problem-Solving Skills
Riki Yohan Nur Permadi; Agus Maman Abadi

Learning is an effort to enhance students' cognitive abilities. Referring to 21st-century learning, one essential skill students must possess is problem-solving ability. APOS theory-based learning can serve as an innovative approach in education. The APOS theory (Action, Process, Object, Schema) explains the process by which students can construct an understanding of mathematical concepts. This study aims to investigate the impact of APOS theory-based learning on improving problem-solving skills. This quantitative study uses a pretest-posttest design. The research sample comprises 31 students from Class VIII A at SMPN

4 Yogyakarta. The material used is probability, with test questions as the research instrument. Data analysis employed the N-Gain statistical hypothesis test. The findings indicate that APOS theory-based learning significantly impacts the problem-solving abilities of Class VIII A students in probability. Therefore, APOS theory-based learning can be considered an alternative instructional model for teaching probability.

Self-Regulated Learning and Mathematics Anxiety: Theoretical Study And Implications in Mathematics Learning fFor The Digital Era Generation

Tiara Jovita Wiji Lestari; Djamilah Bondan Widjajanti; Siti Kholifah

The digital era is a time when digital technology and the internet become an integral part of everyday life marked by easy access to information, technology integration, Artificial Intelligence (AI) development, and transformation across sectors, has changed student characteristic.. In education, students now often rely on technology, prefer interactive, multimedia-based learning, and are comfortable with independent online learning through platforms like Ruangguru, Quipper, and Pahamify. However, in the context of mathematics learning, the digital era also presents challenges in the form of mathematics anxiety, which is a feeling such as discomfort, tension, fear, nervousness, and cold heat associated with mathematics. This mathematics anxiety is closely related to the level of self-regulated learning of students, which is a learning process in which each individual has the initiative to determine what they want to learn, with or without the help of others. The literature study on self-regulated learning and mathematics anxiety concluded that there is an influence between students' self-regulated learning and mathematics anxiety on mathematical communication skills, reasoning skills, problem solving skills, and students' mathematics learning achievement. Therefore, teachers should be able to implement learning strategies that focus on reducing student mathematics anxiety and increasing student self-regulated learning in learning mathematics, utilizing technology to make math more engaging in the digital age.

Mathematical Disposition: Its Role in Improving Learning Achievement in the Digital Era

Citra Arifia Novi Ananta; Djamilah Bondan Widjajanti; Siti Kholifah

This study aims to examine the role of mathematical disposition in improving mathematics learning achievement in students in the digital era. One of the affective abilities that students need to have is related to mathematical disposition which includes the development of aspects of attitudes in mathematics such as self-confidence, diligence, and interest in exploring problem solving. The method used in this study is a literature study by searching for various written sources such as scientific articles, journals, books, archives, or documents that are relevant to the problems being studied. Data collection was carried out by reviewing 10 articles related to mathematical disposition obtained from Google Scholar. Based on the articles reviewed, this study used 10 articles that met the requirements. The results of the review showed that there were several factors that influenced mathematical disposition. The results of this review are expected to provide information to educators regarding the disposition abilities of students in the digital era. Thus, educators can further develop what kind of learning model is suitable for students in the digital era that can support their mathematical disposition abilities.

Room 6, (ISIMMED) (Chair: Muhammad Husein Arafat)
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The Effect of Using Educational Robotics in Learning Physics Material on the Relationship Between Work and Energy on The Development of Computational Thinking Skills

Alfiyah Aini Hanifah

Adoption of Information Technology on the Cultural Heritage Portal of Indramayu Regency using a Descriptive Study Approach

Lusiyana, Mohammad Yani, Robieth Sohiburoyyan, Iryanto

Intangible cultural heritage in Indramayu Regency is often difficult to access and information is scattered, resulting in low public understanding of local cultural riches. To overcome this problem, this research develops a web-based cultural heritage portal which aims to increase the accessibility and dissemination of information related to cultural heritage. This research uses a descriptive study approach to evaluate the impact of the portal on society. The portal provides structured and easily accessible information on various categories of cultural heritage, including national and provincial designations. Data was collected through questionnaire surveys before and after the launch of the portal to measure the changes that occurred. The

research results show significant improvements in ease of access from 46,66% to 93,33%, quality of information from 73,33% to 83,33%, and public understanding of intangible cultural heritage from 44,82% to 56,66%. This portal has proven to be an effective tool in supporting the promotion and preservation of culture, expanding the reach of information to a wider audience

The effect of using educational robotics in delivering student geometry materials on the development of computational thinking skills
Muhammad Husein Arafat

Developing confidence in learning mathematics from anxiety to actualization
Novita Indriyati; Djamilah Bondan Widjajanti; Siti Kholifah

Confidence plays an important role in learning mathematics, yet many students experience anxiety that hinders their understanding and achievement. This article discusses the relationship between self-confidence, mathematics anxiety and self-actualization in an educational context. This anxiety is often caused by uncertainty about one's abilities and monotonous teaching approaches. To overcome this problem, inclusive and fun learning strategies are needed, such as interactive learning methods, group investigation, and role play, which can increase students' confidence. By increasing self-confidence, students can transition from anxiety to self-actualization, where they can utilize their full potential in mathematics learning. This study emphasizes the important role of educators in creating a supportive learning environment to help students achieve academic and personal success.

Students mathematical critical thinking in STEM-based learning
Risnanosanti

The results of the study show that teaching critical thinking in learning in schools and colleges can help students acquire critical thinking skills. Critical thinking skills can grow and develop if facilitated through appropriate learning activities. STEM (science, technology, engineer, mathematics) education is one of the learning activities that can help students develop their critical thinking skills. This qualitative research was conducted to find and describe students' critical thinking skills in solving problems given in STEM-based learning activities. This research was conducted using a basic qualitative research design that used interviews to obtain information on the critical thinking process carried out by students in STEM-based learning. Interview transcripts were analyzed using constant comparative methods. The findings of this study include a description of modeling critical thinking skills, STEM-based learning allows students to practice developing their thinking skills, and teachers can assess students' critical thinking skills using skills-based assessments. The conclusions of this study are in line with what other studies have reported in developing critical thinking skills.

Implementation of Differentiated Mathematics Learning: A Case Study in an Inclusive Classroom with Deaf Students at Tumbuh Senior High School Yogyakarta
Rofi Amiyani; Bayu Adhiwibowo

Tumbuh Senior High School is one of the inclusive schools in Yogyakarta. Inclusive learning is a type of learning that provides opportunities for all students, including those with special needs, to learn together in the same classroom. This research is a case study using a qualitative descriptive method. The purpose of this study is to describe the implementation of inclusive mathematics learning with deaf students. The research was conducted in class 12B of Tumbuh Senior High School, Yogyakarta for one year, namely in the 2023-2024 academic year. Class 12B consists of 8 students, with 5 regular students, 1 student with anxiety disorder, and 2 deaf students. In this study, the researcher is the mathematics teacher in class 12B. During the learning process, the teacher was assisted by a support teacher to facilitate communication with deaf students. Data was collected through observation for one year, interviews with the support teacher, interviews with students in class 12B, and interviews with mathematics teachers who taught in other classes at Tumbuh Senior High School to compare with other class conditions. The results of this study show that mathematics learning in class 12B of Tumbuh Senior High School, Yogyakarta is implemented based on inclusion, which is implemented in accordance with the conditions of each student. Mathematics learning

in class 12B will be designed differently for each student, starting from the depth of the material, the way the material is delivered, examples of questions, practice questions, and exam questions.

Session 4: 10:00-10:55

Room 3, (Chair: Alfiyah Aini Hanifah)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

(**Virtual**) (video) **Engaging Future Secondary Teachers in Technology Experiences**
Marshall Lassak

Work with future secondary teachers should engage them in technology experiences for both teaching and learning mathematics. These tasks should address both content and pedagogical issues. Building on this foundation, this paper shares sample tasks that provide an intellectual need for someone to use technology to solve varying mathematical problems.

The Effect of Using Educational Robotics in Learning Physics Material on the Relationship Between Work and Energy on The Development of Computational Thinking Skills
Cucuk Wawan Budiyanto, Kristof Fenyvesi, Alfiyah Aini Hanifah, et al.

This study aims to: (1) Determine how the developed robotics devices can facilitate Computational Thinking abilities in Geometry learning, (2) Determine how the ER Lego Mindstorm module developed can facilitate Geometry learning. The research was conducted using a qualitative method with subjects being 4th to 6th-grade students from a nature-based school. The sample was determined using purposive sampling and then selected according to specified criteria. The instruments used to determine the impact of robotic devices used in geometry instruction, and the achievement of aspects of Computational Thinking during learning were observation and interviews. Observation and interviews were analyzed using descriptive and content analysis. Based on the research results, it can be stated that (1) Computational Thinking in geometry learning using robotic devices can be well facilitated, (2) The utilization of the ER Lego Mindstorm Module developed to facilitate geometry learning can be used. The hands-on practice makes it easier for students to understand geometry learning.

Room 4, (Chair: Hideyo Makishita)
Zoom Meeting ID for Room 4: 955 6043 6058
Passcode: atcm2024

(**Virtual**) **Connecting Trigonometry to Its Geometric Roots: An Introduction to Trigonometric Values**
Niroj Dahal, Binod Prasad Pant, Bal Chandra Luitel, et al.

This research explores two methods through which ten preservice math teachers develop an understanding of trigonometric values. Using the unit circle, preservice math teachers engage in knowledge-building activities such as paper folding and GeoGebra application. Grounded in Altman and Kidron's 2016 didactical design research, this study examines the cognitive processes ten preservice math teachers undergo during knowledge acquisition procedure. Employing the dynamically nested epistemic action model for abstraction, we analyze how different tasks facilitate ten preservice math teachers' comprehension of unit circle representations for trigonometric expressions and their associated values. Furthermore, we apply the abstraction in context framework to observe how ten preservice math teachers' knowledge progresses from traditional 'triangle' trigonometry to 'circle' trigonometry, aiding in determining trigonometric values.

(**Virtual**) **Classroom Practices with RLA to Promote Inquiry-Based Learning**
Norie Aoki, Hideyo Makishita

In this paper, the author will discuss RLA (Researcher-Like Activity) as a practice that promotes inquiry-based learning, present its characteristics and examples of class practice, and describe its educational effects. The author found that this practice leads to independent, interactive, and deep learning by students. The interactive nature of RLA not only engages students but also involves educators in the learning process.

The effective use of ICT in this practice will also be discussed, encouraging educators to participate actively in their students'' learning.

Psychological Analysis of Students' Perception in Mathematics Learning
Zulfa Roudhatul Mandhasari; Djamilah Bondan Widjajanti; Siti Kholifah

Students' perceptions of mathematics learning play a crucial role in influencing their motivation and engagement in the learning process. Negative perceptions often lead to anxiety and avoidance behaviors towards mathematics, which in turn affects academic performance. This research is a literature review aimed at analyzing students' perceptions of mathematics learning from a psychological perspective. The research method used is a literature review, analyzing various relevant articles and studies. The findings reveal that factors such as prior learning experiences, the role of teachers, the learning environment, and self-efficacy significantly influence students' perceptions. The study emphasizes the importance of using more interactive and relevant pedagogical and psychological approaches to enhance students' positive perceptions of mathematics. The conclusion of this study indicates that fostering positive perceptions can increase students' motivation, reduce anxiety, and improve learning outcomes.

Comparison Analysis of Spatiotemporal and Cross-Sectional Approaches using Fuzzy C-Means Algorithm in Clustering Sexual Violence-Prone Areas in Yogyakarta
Vivi RR Rianto, NH Waryanto

Sexual violence is a serious issue in Indonesia, with the Special Region of Yogyakarta being one of the areas with the highest case rates. Despite the enactment of Law No. 12 of 2022 on Sexual Violence, negative stigma still prevents many victims from reporting incidents. Currently, there is no platform that provides information about areas prone to sexual violence in Indonesia, which is crucial for prevention. This study aims to cluster sexual violence-prone areas in Yogyakarta for the years 2022-2023 using the Fuzzy C-Means (FCM) algorithm, and to compare the effectiveness of spatiotemporal and cross-sectional approaches. The data used in this study includes reports of sexual violence occurring in the Special Region of Yogyakarta during the period 2022-2023. The dataset comprises 156 districts in Yogyakarta and 10 variables, including types of sexual violence such as molestation, child sexual abuse, public indecency, rape, adult molestation, and pornography. The age group parameters include 0-17 years, 17-25 years, and >25 years. The FCM method was applied to cluster the areas based on their risk levels using membership degrees and cluster validity with the Partition Coefficient Index. The results indicate that the clustering outcomes of the two approaches differ. The spatiotemporal approach resulted in Cluster 1 with 36 members, while the cross-sectional approach resulted in Cluster 1 with 21 members. The spatiotemporal approach proved to be more effective in identifying areas prone to sexual violence compared to the cross-sectional approach. The spatiotemporal approach was able to reveal temporal dynamics of sexual violence incidents that were not detected by the cross-sectional approach.

Combination of Momentum and Mean-Variance Strategies in Stock Portfolio Optimization
Retno Subekti; Indira Ihnu Brilliant; Muhammad Goldy

Stock investment is one form of investment that is in great demand by investors. The formation of an optimal stock portfolio is very important because of two main factors: return and risk. Return describes the expected profit, while risk measures the uncertainty of the expected return. One method in portfolio optimization is Mean-Variance (MV), which aims to minimize risk or maximize return. This study combines momentum strategy with the MV method to provide further insight into the optimal portfolio structure. In this study, the portfolio was composed of sharia stocks listed in the Jakarta Islamic Index (JII) 70, using the Sharpe Ratio as an indicator of portfolio performance. The results showed a Sharpe Ratio value of the portfolio of 2.34. This means that the performance of the compiled portfolio can be said to be very good so that the combination of momentum and MV strategies can be used as a sustainable investment strategy.

(Virtual) Indonesian and Nigerian Elementary School Teachers' Experiences of Overcoming Mathematics Teaching Anxiety: A Comparative Study

Jamiu Temitope Sulaimon and Muhammad Irfan

This study will examine the experiences of elementary school teachers in Indonesia and Nigeria in confronting and overcoming mathematics teaching anxiety, recognizing the critical role teacher confidence plays in shaping student learning outcomes. Teachers play a critical role in their efforts to provide meaningful mathematics learning to students, so that students do not experience learning anxiety. However, a considerable body of research has highlighted the prevalence of mathematics anxiety among students and this anxiety is often transmitted from teachers to their students. The research questions will address the level of anxiety among elementary school teachers in Indonesia and Nigeria, the causes of mathematics teaching anxiety, and the strategies teachers employ to overcome these challenges. The study will test the hypothesis that there is no significant difference in the level of anxiety among primary school teachers in Indonesia and Nigeria. The comparative approach of this study will allow for a nuanced understanding of how cultural context influences mathematics teaching anxiety and the coping strategies employed by teachers in different settings. The study will utilize a descriptive survey research design, employing quantitative collection methods. The population of this study comprises all teachers teaching in elementary schools in Indonesia and Nigeria, with a stratified random sampling technique used to select a representative sample of 400 elementary mathematics teachers. Two researcher-developed instruments will be used: the Level of Anxiety among Elementary School Teachers in Indonesia and Nigeria Rating Scale (LAESTINRS) and the Causes and Strategies Employed to Overcome Mathematics Teaching Anxiety Questionnaire (CSEOMTAQ). Data analysis will use descriptive statistics to analyze research questions while hypothesis will be tested using independent T-test. The findings from this study will generate avenues for future research, such as exploring the relationship between mathematics teaching anxiety and student outcomes, investigating the effectiveness of different interventions and support systems for reducing mathematics teaching anxiety, and examining the influence of cultural context on the causes and coping strategies for mathematics teaching anxiety. The significance of the study lies in its implications for educators, policymakers, and educational researchers. It will contribute to a deeper understanding of the specific challenges faced by elementary school teachers in Indonesia and Nigeria, informing the development of targeted training programs and professional development opportunities that address the root causes of mathematics teaching anxiety.

(Virtual) Design of Digital Literacy Scale in Mathematics Learning for Junior High School Students: Validity and Reliabilty Study

Nur Lailatul Azizah; Janrino JR Fanggidae; Ariyadi Wijaya; Wahyu Setyaningrum

Along with development technology, digital learning lots applied in various learning including mathematics learning. It is not enough just to have facilities and infrastructure available. Teachers and students need to have good digital literacy, so they can implement digital learning in mathematics learning. The purpose of the study is to develop an instrument to measure students' digital literacy in mathematics learning.
The method used in the study is study development consisting of three stages, that are stage study initial, design, and trial. At the initial stage, the study obtained six aspects of developed digital literacy, namely technical skills, information, communication, creativity, security, and problem solving. Trials were conducted on 250 students the 8th grade of Junior High School. Analysis of trial result data is used to know validity level and reliability instruments that have been developed. Validation in this study consists of validation content and validation empirical. Validation is done with a request opinion expert and quantified use of the Gregory index whereas validation empirical used a validation construct with CFA to see the ability of each item question on the instrument. Reliability instrument in this study be measured using Cronbach Alpha reliability. Research results show that instrument digital literacy questionnaire in mathematics learning that has developed fulfill valid criteria with level validity content and reliability respective instruments are in high category. Based on CFA results, from the 20-item questions, there are 11 items valid questions with factor loadings above 0.3. Therefore that is, the questionnaire that was developed can be used and developed more carry on.

Cognitive Loads Analysis on Mathematics Learning Media: Text Book and Interactive Simulations

Arum Nur Wulandari, Imam Sujadi, Ira Kurniawati, Riki Andriatna, Yuli Bangun Nursanti

Presentation of teaching materials through media requires planning that considers many factors includes cognitive load and the principles of multimedia learning. Therefore, this research tries to compare cognitive loads from the use of textbooks and interactive simulations. The method used in this research is descriptive qualitative. From the analysis that has been done, it is known that presentation through multimedia is not always more effective than conventional presentation. This is due to the limitations of cognitive load associated with divided attention or the lack of presentation of work examples in the presentation of multimedia-based teaching materials such as interactive simulators. However, the written presentation can also increase additional load, for example, the presentation of too much material in long written texts without relevant scaffolding or explanatory images. However, based on the literature review, excessive interactivity can also increase cognitive overload so it is necessary to consider the level of interactivity.

Session 5: 11:00-11:55

Room 3, (Chair: José Manuel Dos Santos)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

Preparing Math Teachers for the Future: Analysing the Use of Technology in a Master's Program

José Manuel Dos Santos, Jaime Carvalho e Silva, Zsolt Lavicza

Current guidelines for the mathematics curriculum from primary to secondary education in Portugal include Computational Thinking as a cross-curricular theme and advocate for the systematic use of technology. Official mathematics program documents pro- vide methodological suggestions for teachers to develop computational thinking through the use of dynamic geometry environments, such as GeoGebra, internet applets, Scratch, and Python. In this context, it is important to understand how future teachers interpret the use of these technological tools in the first year of a Master's degree in Teaching Mathematics for Basic and Secondary School Teachers in Portugal. This study analyses the work of 12 students during the "Computational Tools for the Teaching of Mathematics" course unit. Supported by the research-based design methodology, the study examines the work carried out over two school years, as well as the adjustments made between the first and second cycles of this intervention, using qualitative data analysis techniques. The results indicate that the integration of content knowledge and technological knowledge among the partici- pants is complex throughout the two intervention cycles. Combining pedagogical content knowledge with technological and content knowledge presents new challenges for the initial training of mathematics teachers. This study offers insights to improve the course unit for future editions and identifies issues to consider for continuous teacher training in Portugal.

Online learning incorporating a mathematics online test system and a dynamic geometry system

Chieko Komoda, Yasuyuki Kubo, Satoshi Yamashita, et al.

This research reports on the creation of rich mathematical content for secondary education in Japan using the open-source e-Learning platform "Moodle". The study focuses on utilizing the "page" and "quiz" functions to incorporate complex mathematical ex-pressions and dynamic mathematical graphs as teaching materials. Additionally, the "KeTCindyJS" is used for generating dynamic graphs, and the "STACK" system is employed for automatic grading to evaluate learners' mathematical knowledge. The primary goal is to develop quizzes within Moodle that integrate advanced mathematical graphs

Room 4, (Chair: Alasdair McAndrew)
Zoom Meeting ID for Room 4: 955 6043 6058
Passcode: atcm2024

Some Poncelet invariants for bicentric hexagons

Grant Keady, Alasdair McAndrew

Tangential polygons are (convex) polygons for which every side is tangent to an inscribed circle. Cyclic polygons are those for which every vertex lies on a circle, the circumcircle. Bicentric n-gons are those which are both tangential and cyclic. Every triangle is bicentric. Bicentric quadrilaterals are those for which the sum of the lengths of opposite sides is the semiperimeter and for which opposite angles sum to pi. Here we

give some results pertaining to invariants of (convex) bicentric hexagons.A remarkable result of Poncelet is that if one has a pair of circles admitting a bicentric n-gon, then for every point on the circumcircle can be a vertex for a bicentric n-gon. This is illustrated in the animation at
https://mathworld.wolfram.com/PonceletsPorism.html

The animation indicates that, along with the incentre and circumcentre, the point of intersection of the principal diagonals of a 2m-gon is invariant under the motion. Such invariants -- here called Poncelet invariants -- have been studied for two centuries, in particular for triangles and bicentric quadrilaterals. We present results, for bicentric hexagons, that various combinations of distances between vertices - lengths of diagonals and of sides - are invariant. CAS supplements are available for checking the results.

Exploring Conic Sections through Desmos Artworks: Where Math, Art, and Technology Combine

Maria Digi Anna Mance-Avila, Maria Alva Aberin

Teaching graphs of equations and inequalities to students may be difficult without appropriate visual tools. To help teachers and students visualize graphs, a free online graphing calculator called Desmos can be used, as it allows its users to graph equations and inequalities, plot points, add sliders, and much more. These features make Desmos a useful tool for teachers as they teach graphing concepts and create interactive activities for their students. Likewise, students can create and explore various graphs independently or develop their own activities collaboratively. This workshop showcases how Desmos can be used to support the learning of graphs and promote creativity in a mathematics class by integrating students' knowledge of graphing and their love of the arts. By participating in this workshop, you will see sample artworks submitted by senior high school students and receive tips on how this activity can be used to help students visualize and understand graphs more clearly while tapping into their creative side. Participants should bring a laptop computer with internet connection. You may access the following links to explore sample Desmos artworks: (https://www.desmos.com/calculator/99apvboe8b) and (https://www.desmos.com/calculator/48izadukqk)

(Virtual) A Coincidence Point Theorem of Pointwise Contraction Mappings in Generalized Modular Metric Space

Lusi Harini; Agus Maman Abadi; Karyati

Fixed point theorem has many important applications in various fields, such as biology, chemistry, physics, economy, and etc. As for mathematics, it guaranteed the existence of differential equation system solution and investigate the stability of the solution. In this research we will investigate about the fixed point of a special type mapping which is called pointwise contraction mapping in generalized modular metric space. Moreover we will investigate about the conditions so that if we have two pointwise contraction mapping with the same domain, then we always get a coincidence point. The result shows that the domain of the mapping must be a closed, bounded, and compact set (in term of generalized modular metric) to ensure the existence of the fixed point and the coincidence point will exist if one of the mapping is injective.

(Virtual) Hybrid CNN-BiLSTM Model for Forecasting Rice Price Fluctuations in Indonesia

Aulia Hasanah Nur Rahman; Gumgum Darmawan; Budhi Handoko

Rice prices fluctuations in Indonesia is a crucial phenomenon that affects economic stability and the welfare of the community. During the period from 2017 to mid-2022, prices tended to be stable despite often experiencing significant fluctuations. However, since mid-2022, rice prices have begun to rise quite sharply. This research aims to forecast rice prices using a CNN-BiLSTM model. This model was chosen for its ability to capture complex and continuous data patterns. Our study compared the performance of the CNN-BiLSTM model with several methods. The results indicate that the CNN-BiLSTM model is capable of producing more accurate predictions. This is evidenced by the Mean Absolute Percentage Error (MAPE) value being below 5%. The main contribution of this research is the provision of a more advanced predictive tool to monitor and manage rice price fluctuation, which can ultimately be used to make more informed decisions in facing future price instability.

The Role of Teaching Materials in Improving Students' Mathematical Problem Solving Abilities: Does It Have an Influence?
Fitri Nur Asanti

The teaching and learning process is closely related to the use of teaching materials. The teaching materials used should be able to build students' existing abilities, one of which is mathematical problem solving abilities. However, until now students' mathematical problem solving abilities are in the low category. Based on a survey conducted by PISA in 2022, it can be seen that Indonesian students' mathematical problem solving abilities are still below the international level. In this research, an analysis will be shown regarding the influence of teaching materials in building students' mathematical problem solving abilities. Through a quantitative approach with a pre-experimental design type of research using a one-group pretest-posttest design. Data analysis used N-Gain inferential analysis with 30 students as subjects. The results of this research are that there is an influence of electronic teaching materials on mathematical problem solving abilities. This can be seen from the average test increase in mathematical problem solving ability scores reaching 0.6510 or 65%.

Room 7, (ISIMMED) (Chair: Hanan)
Zoom Meeting ID for Room 7: 976 0547 7176
Passcode: atcm2024

(Virtual) How Could Teacher Professional Program Students design Numeracy Assessments?
R. Rosnawati; Ariyadi Wijaya; Tuharto; Caturiyati

The basic competency that is one of the learning evaluation tools in Indonesia is numeracy. Therefore, teacher professional program students as prospective mathematics teachers need to understand numeracy. The results of the study show that the numeracy questions developed by teacher professional program students are questions to measure basic level numeracy. Efforts are still needed to improve the ability of teacher professional program students in developing numeracy instruments, so that they are able to develop questions at all cognitive levels and the diversity of contexts used.

(Virtual) Item Analysis of Mathematics Middle Assesment at Junior High School
Hanan; Kana Hidayati

Evaluation is an important thing to do to measure and know the quality of something. Evaluation is a form of assessment in order to be able to take the right steps for the future. In the education system, evaluation is not only important to see the quality of education, but also to see the extent of the shortcomings of the implementation of learning that has been carried out previously. In addition, evaluation is useful for determining the next steps that must be taken. Mid-Semester Assessment is an assessment carried out to see the success of learning carried out for half a semester. Mid-Semester Assessment is included in summative assessment when associated with the independent curriculum. In summative assessment, it is important to know the quality of the instruments used in the assessment. It may be that if the assessment results are not satisfactory, the error does not lie in the lack of student understanding, but lies in the instrument used, which is included in the poor category. The main objective of this study was to determine the quality of the questions used in the Mid-Semester Assessment at SMPN 3 Yogyakarta. The aspects measured in this study were the validity and reliability of the questions, and to determine the index of the level of difficulty of the questions. This is because the instrument used in PTS at SMPN 3 Yogyakarta was in the form of 30 multiple-choice questions. This study was conducted using a quantitative method. The results of the study showed that 90% of the questions were valid, and the PTS questions were reliable. In addition, 11 questions were in the moderate category and 19 questions were in the difficult category.

Emotional Intelligence and Adversity Quotient in View of Students' Mathematical Problem-Solving Skill
Nurul Bayyinah, Retno Subekti

Problem solving skill plays a crucial role in the mathematics learning. Strong mathematical problem-solving skills enhance the overall effectiveness of mathematics education. Mathematical problem-solving skill are influenced from affective factors such as emotional intelligence and adversity quotient. The aims of this research to review the literature on emotional intelligence & adversity quotient with respect to students'

mathematical problem-solving skills. The research method employed is a literature review, which involves examining various references and relevant research findings to establish a theoretical foundation for the current study. Data collection is conducted by identifying and gathering relevant research electronically. The findings indicate that emotional intelligence and adversity quotient have a direct impact on mathematical problem-solving skill. Additionally, the study reveals that emotional intelligence significantly affects these abilities, while adversity quotient also has an impact. This research of result can be utilized to enhance mathematical problem-solving skills by considering students' emotional intelligence and adversity quotient.

Session 6: 13:00-13:55

Room 3, (Chair: Ming-Gong Lee)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

Applications of GPT and Copilot in Tourism Courses: A Case Study in Chung Hua University
Ming-Gong Lee, Che-Yuan Yang

We utilize AI tools, ChatGPT and Copilot, to courses in Tourism college. Their functions allow students to achieve target through simple instructions and creative spells to these tools. Without working on advanced AI programming, students can meet and even reach success of their performance far beyond their imagination. Utilization of these AI tools in the hospitality courses should be encouraged so that engineering types of learning in various programming languages can be minimized to encourage hospitality students to participate in AI applications.

A case study of the creation of questions for a math e-learning system STACK using GeoGebra
Yasuyuki Nakamura

STACK (System for Teaching Assessment using a Computer Algebra Kernel) is a system that can automatically grade mathematical formulae and is available as a question type in LMSs such as Moodle. Mathematical formulae can be entered as answers to online tests, such as calculation questions, and automatically graded, with partial points awarded based on the answers. Maxima, a computer algebra system, is used to evaluate these formulas. Flexible feedback can also be provided based on the answers, and this feedback is intended to be used for self-study. These functions are based on the Potential Response Tree mechanism, which uses a branching evaluation of the assumed answers using various indicators. When submitting questions, the numerical values can be randomized, and different questions of the same type can be presented at random to support drill-like repetitive exercises. It is also possible to ask questions involving graphs and figures using Maxima"s plot function and JSXGraph. These graphs and figures can also be randomized by setting parameters.

Accepted answer formats include mathematical expressions such as polynomials and rational expressions, as well as matrices of arbitrary size. Other types of questions, such as those requiring the evaluation of numerical values with set precision and the calculation of units, are also possible. Recently, it has become possible to create questions using the dynamic geometry software GeoGebra. For example, by creating questions that require the user to draw a graph or vector corresponding to a given mathematical expression, the software can be applied to problems in both physics and mathematics. In this presentation, some examples of questions using GeoGebra will be provided, and their applications will be discussed. For instance, in mathematics, questions may involve drawing graphs corresponding to specified mathematical expressions (although, except for linear functions, the graphs cannot be freely drawn). In physics, problems may involve drawing vectors such as forces acting on objects and the velocities and accelerations of objects.

Room 4, (Chair: Hitoshi Nishizawa)
Zoom Meeting ID for Room 4: 955 6043 6058
Passcode: atcm2024

Impact on Student Learning Outcomes in Mathematics using GeoGebra

Werachai Pattanapiboon, Hitoshi Nishizawa

In recent years, dynamic geometry software tools for teaching and learning in mathematics have been an integral part of a technology-based learning environment and become ubiquitous in educational institutions. The learning strategy assisted by these mathematics software tools allows students to better understand abstract contents with symbolic expressions through computer visualization with interactive and dynamic graphical representation. This paper presents the study of the effect of using dynamic geometry software, GeoGebra, on student performance and learning skills of geometrical concepts in mathematics teaching. The study was conducted for two groups with the same learning contents but different teaching styles for lectures with and without using GeoGebra software. The collected data from the students' learning records, including post-test scores, were analyzed, focusing on two categories of symbolic calculations: graphs and inequalities. The performance of two teaching styles was evaluated based on the student achievements on paper-based quizzes, considering the number of retrials and the success rates. This study also investigates the impact of using GeoGebra on student learning skills by comparing score distributions for symbolic calculations and graphs and inequalities categories among three different academic years. The results show that integrating mathematics visualization software in teaching algebra can significantly improve student learning outcomes, providing higher post-test average scores when compared with the conventional teaching style. The results also reveal that using GeoGebra as a teaching tool considerably enhances students' graphing skills and understanding of geometrical concepts in mathematics, particularly in graphing functions and solving inequalities. In addition, the effectiveness of using GeoGebra for improving mathematics learning outcomes for low-performing students has been confirmed with a higher success rate and lower number of retrials for paper-based quizzes. Thus, early intervention in using GeoGebra to enhance students' visualization and graphing skills might be helpful, particularly for graphing functions and solving inequalities.

Challenges and Perceptions of Mathematics Teachers Towards Digital Textbook Adoption

Tommy Tanu Wijaya, Yiming Cao, Xinxin Li

The advancement of technology in mathematics education has been found to have a positive impact. This technological progression has also influenced the transition from printed to digital mathematics textbooks. Digital mathematics textbooks are electronic books that incorporate interactive content, multimedia integration, and adaptive learning technologies designed to enhance the educational experience. Unlike traditional textbooks, digital versions offer dynamic content that can be updated in real time, providing the most current information and methodologies. They also facilitate personalized learning paths, allowing for differentiated instruction that can cater to the unique needs of each student. These textbooks often include tools for assessment, instant feedback, and analytics, enabling teachers to track student progress and adapt instruction accordingly. Some experts believe that this shift aligns with 21st-century developments and will provide numerous benefits and opportunities for future educators. However, the adoption of digital mathematics textbooks presents distinct challenges for mathematics teachers. Despite full support for the use of digital resources, the implementation of digital mathematics textbooks remains suboptimal. This study aims to identify the usage of digital mathematics textbooks by teachers, their perceptions of these resources, and the challenges they face during instructional activities. We employed a quantitative approach to assess the utilization of digital textbooks by teachers, followed by a qualitative approach using interviews to explore the perceptions and challenges associated with their use in teaching mathematics. The participants of this study included 289 mathematics teachers in China who have previously used digital mathematics textbooks in their teaching practices. Five teachers were purposively selected based on age, gender, and teaching experience to participate in follow-up interviews. Our findings reveal that the respondents possess basic knowledge about utilizing digital mathematics textbooks for teaching. However, 65.08% of the teachers reported using digital textbooks only 1-2 times per semester, typically for special occasions such as competitions or open classroom sessions. Many teachers infrequently use digital textbooks due to a belief that these resources do not significantly impact learning outcomes and require more effort compared to traditional teaching methods. The reluctance to adopt digital textbooks more broadly suggests a gap in teachers'' understanding or trust in the efficacy of digital tools in enhancing mathematical learning. It is recommended that educational leaders integrate comprehensive training programs focusing not only on the operational use of digital textbooks but also on pedagogical strategies that leverage digital resources to improve learning outcomes. Additionally, developing a feedback loop where teachers can share their experiences and challenges could foster a more supportive community of practice. This engagement could be facilitated through regular workshops, peer-to-peer sessions, and integration of user-friendly analytics

in digital textbooks to track and reflect on student performance in real time. Furthermore, policymakers should consider incentivizing schools that demonstrate innovative uses of digital technologies in their curriculum, encouraging a broader shift towards digital resources. These initiatives could significantly reduce the reluctance observed among mathematics teachers and help realize the potential benefits of digital mathematics textbooks in enhancing student learning and engagement.

(Virtual) Application of Exponential Generalized Autoregressive Conditional Heterocedasticity for Estimating Sharia Stock Risk

Arnetta Dola Febyana; Retno Subekti

Based on the State of the Global Islamic Economy (SGIE) Report 2023, the development of Indonesia's Islamic economic ecosystem is getting better. Indonesia has great potential to develop the Islamic financial industry through offering Islamic stock investment instruments. In making investments, of course, good risk management is needed. This research aims to model volatility with the ARMA-EGARCH model and estimate risk with the Value at Risk (VaR) method on Islamic stock returns that have asymmetric properties on the Jakarta Islamic Index (JII). The data used in this study consisted of four Islamic stocks namely BRIS, PTBA, TPIA and UNTR which were taken from the period June 1, 2020 to April 30, 2024 through the yahoo.finance website. Data analysis is carried out with the ARMA model to model the conditional average and the EGARCH model to model the volatility of stock returns that have asymmetric properties. The steps of data analysis in this study are data exploration, model parameter estimation and model diagnostic testing, and estimating VaR values. The estimation and forecasting results of the ARMA-EGARCH model are used to calculate VaR on assets. The results of this study indicate that the application of the ARMA-EGARCH model can accommodate volatility responses that have heteroscedasticity and asymmetric properties. The estimated VaR values with 95% and 99% confidence levels for each stock are 2.6% and 2.4% (BRIS stock), 3.2% and 6.1% (PTBA stock), 4.7% and 20.8% (TPIA stock) and 3.5% and 5.9% (UNTR stock), respectively.

(Virtual) Determining Minimum Sample Size for a Stable Classification Performance with Rare Events Data Using RE-WLR: A Case Study on Student Study Success

Asma Khoirunnisa; Heri Retnawati; Muhammad Lintang Damar Sakti

Researchers often encounter challenges in determining the minimum sample size required to establish stable performance of machine learning classification models. This study seeks to address this issue by identifying the minimum sample size necessary to achieve consistent classification performance in binary response models within the context of sparse case data, specifically focusing on studies related to student academic success. The methodology employed involves sampling simulation using bootstrapping techniques across various sample sizes, followed by the evaluation of model performance using the G-Mean metric. Machine learning techniques, including Logistic Regression and Rare Event Weighted Logistic Regression (RE-WLR), are utilized to ascertain the minimum sample size threshold capable of producing an optimal and reliable model for classifying rare events. The results indicate that the RE-WLR method outperforms Logistic Regression in reducing classification bias within the minority class, particularly when utilizing parameter estimates in the form of Maximum Likelihood Estimates (MLE). Furthermore, the research findings highlight that sample sizes below a certain threshold (n=600) tend to yield unstable and less accurate models, particularly in datasets with highly imbalanced class distributions. Establishing this minimum sample size holds significant importance in enhancing the efficiency of research within the domain of education, especially in scenarios involving rare case data, such as predicting student academic success. Additionally, the determined minimum sample size serves as a valuable guideline for researchers in structuring more effective research designs.

Addressing Interactivity Challenges in Network-Based Media for Mathematical Competence

Sri Andayani; Djamilah Bondan W; Thesa Adi Saputra Y

This research and development (R&D) study aims to create network-based mathematics learning media, specifically web-based instruction (WBI), to address the challenges of interactivity in enhancing mathematical competence. The development process follows the ADDIE model, encompassing Analysis,

Design, Development, Implementation, and Evaluation stages. The outcome of this research is a WBI platform tailored for high school students, designed to improve their mathematical skills. To evaluate the interactivity challenges, data on WBI interactivity were collected through questionnaires completed by teachers and students. The questionnaires assessed three key indicators: (a) student-to-content interactivity (SCI), (b) student-to-teacher interactivity (STI), and (c) student-to-student interactivity (SSI). These data were used to determine the interactivity level scores. The findings indicate that the developed WBI includes interactivity features aligned with the three indicators, achieving a score in the "very good" category. Additionally, this study explores the specific challenges encountered in developing interactive WBI for mathematics learning.

Room 7, (ISIMMED) (Chair: Rofi Amiyani)
Zoom Meeting ID for Room 7: 976 0547 7176
Passcode: atcm2024

Literature Review: "Learning Design with Worked Examples in Reducing Cognitive Load in Mathematics Learning"
Sumarni Susilawati

This literature review study is motivated by the phenomenon of math anxiety that occurs in students caused by cognitive factors. Cognitive aspects are very influential aspects in learning because they are related to the ability to understand knowledge, analyze and solve problems. High cognitive load will hinder the process of knowledge transfer in learning. Cognitive load will increase when unnecessary demands are placed on the cognitive system. Some learning procedures require students to process many elements simultaneously which can cause cognitive load that leads to failure of the learning process. Therefore, learning design and media need to be a concern to assist students in reducing the cognitive load of learning. From some research shows that the learning design that can be used to reduce cognitive load is the Worked example approach. Worked examples mobilize the learner's attention to the stated problem and the steps required to solve a particular type of problem. Thus, this article describes how to reduce cognitive load in mathematics learning by using worked examples. Then, it also presents empirical evidence related to the use of worked examples in mathematics learning that can help students easily understand the learning material. Based on some previous research results, it is known that learning with a worked example approach is able to reduce cognitive load, so that the transfer of knowledge can run well and give good results on the tests conducted. The only thing that needs to be a concern and consideration for the use of worked examples is, paying attention to the results of the initial ability test of students. Are they still classified as beginner learners who do not have adequate prior knowledge, or are they already at the expert stage or able to solve problems because of adequate prior knowledge and no longer need training with worked examples.

Bibliometric Analysis of Learning Design Trends Based on Animated Videos to Achieve Problem Solving Skills in Comparison Materials
Afifah Ainun Nadjla

This study aims to identify the trend of animated video-based learning design in improving problem-solving skills in value comparison. Data were collected from 204 documents retrieved from the Scopus database, using bibliometric analysis techniques with RStudio and VOSviewer. The results of the analysis showed an increase in publications of 7.23% per year from 2019 to 2024. The most productive affiliations include University of California, Stanford University, and National University of Singapore. Journals such as Computers & Education and Journal of Educational Technology & Society show the highest h-index in this field. The most cited article is by Mayer & Moreno (2002), which discusses the principles of multimedia design in education. Keywords recommended for further research include video-based learning, problem-solving skills, comparative education, and animated educational videos. This research confirms the importance of technology-based approaches in mathematics education and provides guidance for future studies.

Math Anxiety and Adversity Quotient: How Does It Affect Students' Mathematical Problem-Solving Skills?
Yuni Apriani; Ali Mahmudi

Math anxiety is a feeling of fear and anxiety when facing something related to mathematics. Adversity quotient is a person's ability to face challenges and difficulties. This study aims to analyze the results of a

study that examines the influence of math anxiety and adversity quotient on mathematical problem-solving skills. The research method is the systematic literature review. The sources of literature used are national and international articles collected from Science Direct and Google Scholar from 2017 to 2024. Based on the analysis of 29 articles that met the criteria, the results of the study were obtained as follows: 1) Math anxiety and adversity quotient influence mathematical problem-solving ability; 2) Math anxiety has a negative influence on mathematical problem-solving ability; 3) Adversity quotient has a positive influence on mathematical problem-solving skills; 4) Based on the Polya problem-solving stages, only students with low math anxiety and students with adversity quotient climbers can fulfill all stages well.

Session 7: 15:30-16:25

Room 3, (Chair: Russel Carlson)
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Constructing Multi-layered Acrylic Tiling Models Using Laser Engraving and Cutting
Mark Loyola, Ma. Louise Antonette De Las Peńas, Mark Tomenes

This work discusses the creation of tiling or tessellation models that support the teaching of mathematics. The geometric models are first constructed using a computer algebra system and then realized as tangible manipulatives using laser engraving and cutting.

AI, Tensors, and Math Homework
Russel Carlson

Many of the current advances in artificial intelligence are based on the mathematics of tensor spaces and optimization. However, most math instructors are not well versed in tensors, as it is often taught as an abstract topic in graduate algebra classes. The purpose of this paper is to help describe tensors and their properties, and how they are used in artificial intelligence. Also, this paper will examine how this informs the behavior of artificial intelligence when it is used to answer mathematics questions.

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Analysis of the RME Approach Integrated with GeoGebra Based on a Literature Review Study
Asrina Mulyati; Yunita Nurpriya Sari; Merryanti

This study aims to analyze the effectiveness of the Realistic Mathematics Education (RME) approach integrated with GeoGebra software in mathematics learning. Utilizing a literature review method, this research identifies the contributions and impacts of GeoGebra integration within the RME approach on enhancing students' conceptual understanding and problem-solving skills. The findings indicate that the combination of RME and GeoGebra positively influences the mathematics learning process through visualizations that enhance student engagement. This study recommends the integration of GeoGebra as an interactive tool in RME to achieve more effective learning outcomes.

Mean Learning with Problem Baed Learning to Improve Students' Problem Solving Ability
Lina;Angraeni

Mathematics is a complex problem-solving activity, not just a linear thinking. Problem solving has a significant impact on mathematical thinking. Teaching math through problem solving generally means that children solve problems to learn new math, not just to apply math once learned. This study aims to examine the effectiveness of the Problem Based Learning method in improving junior high school students' problem solving skills on Mean (average) material. The method used is quantitative research. The research sample consisted of VIII grade students in one of the junior high schools in Yogyakarta. Data were collected through problem solving ability tests before and after treatment. The data were analyzed using descriptive and inferential statistical tests to see significant differences between the two groups. The results showed that students who learned with PBL method experienced significant improvement in problem solving ability compared to students who learned using conventional methods. This finding supports the use of PBL as an effective learning strategy in improving students' problem solving ability, especially in learning mathematics on the concept of Mean.

The Effect of Positive Affirmation in Worked Example-Base Mathematics Learning on Transfer Ability, Cognitive Load, and Mathematical Anxiety

Noka Setya Maharani; Endah Retnowati

This study aims to examine: (1) the effect of growth mindset strategi using positive affirmation and without positif affirmation; (2) the effect of learning strategy using WE – PS dan PS – PS; (3) the interaction effect between growth mindset strategi (positive affirmation vs without positive affirmation) and learning strategy (WE – PS vs PS – PS). In Addition, gender differences will also be tested. All tests are reviewed from the transfer ability, cognitive load, and mathematical anxiety. This experimental research with 2 x 2 factorial design involves the factors of growth mindset strategy (positive affirmation vs without positive affirmation) and learning strategy (WE – PS vs PS – PS), resulting in four experimental groups, that are: (1) WE – PS with positive affirmation; (2) PS – PS without positive affirmation; (3) PS – PS with positive affirmation; and (4) PS – PS without positive affirmation. Learning was conducted throught three phases, namely the introductory phase, the acquisition phase, and the test phase. The study was conducted in one of the public junior high school in Ngaglik district involving 128 students (59 boys and 69 girls) with an anverage age of 13.81 years. All students studied line and angle materials and each student was randomly assigned to the experimental groups that had been designed. The instrument used were near transfer dan far transfer ability test, self-rating cognitive load near transfer and far transfer ability tests, and self-rating mathematical anxiety learning and mathematical evaluation. ANOVA (Analysis of Variance) was used to test for main effect and interaction effect with a significance level of 0.05. The result of the analysis showed that there was no effect growth mindset strategy on all dependent variabels. There is an effect of learning strategy on cognitive load of far tranfer ability test and learning mathematics anxiety. Ther is an effect of gender on cognitive load of far transfer ability test an evaluation mathematical anxiety. Although there was no interaction effect between growth mindset strategy and learny strategy on all dependent variabel tested, there was an ineraction effectt between growth mindsett strategy and gender on far transfer ability and far transfer cognitive load. In addition, learning strategy and gender also provide interaction effects on near transfer ability, lerning mathematics anxiety, dan evaluation mathematics anxiety. Positive affirmation should be given to female students.

Selection of Optimal Knot Points and Oscillation Parameters Using Generalized Cross-Validation (GCV) and Unbiased Risk (UBR) Methods in Semiparametric Regression with Mixed Estimator of Truncated Spline and Fourier Series

Askin Nur Habibah; I Nyoman Budiantara; Jerry Dwi Trijoyo Purnomo

Semiparametric regression is a regression approach used when the shape of the regression curve is assumed to be partly known and partly unknown. Some of the methods included in semiparametric regression are truncated Spline and Fourier series. Determining the optimal knot points on a truncated Spline can affect the model's ability to capture data patterns, and the selection of oscillation parameters on a Fourier series serves to adjust the oscillations to suit the characteristics of the data. Determining the optimal knot points and oscillation parameters in semiparametric regression with mixed estimators of truncated Spline and Fourier series has an important role in improving the accuracy of the model and affecting the regression curve formed. In this case, the Generalized Cross-Validation (GCV) and Unbiased Risk (UBR) methods are two approaches that are often used in the selection of optimal knot points and oscillation parameters. The purpose of this study is to examine the GCV and UBR methods in determining the optimal knot points and oscillation parameters in semiparametric regression with mixed estimators of truncated Spline and Fourier series.

Nonparametric Regression Estimation for Panel Data Using a Mixed Truncated Spline and Fourier Series

Ni Komang Jeni Frika Yanti; I Nyoman Budiantara; Vita Ratnasari

Nonparametric regression is an approach that has great flexibility in describing the relationship between variables without requiring the assumption of a particular function shape. Many studies on nonparametric regression have been conducted using one form of estimator. Many nonparametric regression studies have used one type of estimator for all predictor variables. However, because each predictor variable often has

a different pattern, the use of one type of estimator can produce estimates that are less in line with the actual data pattern. Then it is further developed using a mixed estimator. Previous research only applied the mixed estimator to cross section data. Therefore, this study develops research on nonparametric regression with a mixed spline truncated and fourier series estimator applied to panel data, where observations are made on the same subject over several time periods. The purpose of this study is to estimate the parameters of the nonparametric regression model with a mixed estimator of truncated spline and Fourier series applied to panel data. The theoretical study in this study is focused on the form of the mixed estimator obtained using Weight Least Square (WLS) estimation. The results of this study produce a mixed estimator of truncated spline and Fourier series in nonparametric regression on panel data obtained through the Weighted Least Squares (WLS) method through the Weighted Least Squares (WLS) method.

A Semiparametric Regression for Modelling Life Expectancy : Spline Truncated and Fourier Series Estimators

Firda Fadri ; Kiswara Agung Santoso ; Sandya Nur Indrawati Karsan

Regression approaches were categorized into parametric, nonparametric, and semiparametric. Parametric regression models required assumptions about the form of the relationship function, as seen in simple linear regression. Whereas, nonparametric regression models did not require specific assumptions, making them more flexible in capturing complex and non-linear patterns. When the relationship between variables was not entirely linear or non-linear, the semiparametric approach was used, combining parametric and nonparametric components to improve model accuracy. This study modeled the Life Expectancy (LE) in East Java Province for the year 2022 using a semiparametric regression approach that combined truncated spline and Fourier series estimators. This approach integrated a parametric linear model for the literacy rate, and nonparametric models: a truncated spline for the Labor Force Participation Rate variable, and Fourier series for the variables Infant Mortality Rate, Percentage of Young Children (ages 0-23 months) Receiving Breastfeeding, and Average Years of Schooling. The choice of knots in the truncated spline was determined based on the range of Average Years of Schooling values. Fourier series were used to capture periodic patterns, with different oscillation variations for each variable. The optimal model combination included one truncated spline component and three Fourier series components. The research results showed that the GCV value obtained from the model was 2.899, and the MSE value was 1.2519. The coefficient of determination obtained was 85.66%, indicating that this model was able to explain a substantial portion of the variability, and the semiparametric approach better captured the complexity of the data.

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Parameter Estimation of Zero Inflated Bivariate Ordered Probit Model with Brendt, Hall, Hall, and Hausman Iteration Approach

Andriano; Purhadi; Ismaini Zain

Probit regression is a statistical analysis method used to analyze the relationship between response variables and predictor variables where the response variable is categorical with a normal distribution link function . Based on the measurement scale, probit regression is divided into two, namely binary probit regression and ordinal probit regression. Based on the number of response variables, ordinal probit regression is divided into two, namely univariate ordinal probit regression and multivariate ordinal probit regression. Multivariate ordinal probit regression that has two response variables is called bivariate ordinal probit regression. In univariate ordinal regression, if there are many unequal proportions in certain categories, conventional univariate probit ordinal regression cannot provide good estimation results. Therefore, univariate ordinal probit regression must be developed into Zero Inflated Ordered Probit (ZIOP) Regression. Similar to univariate ordinal probit regression, bivariate ordinal probit regression produces poor estimates if the response variable is zero inflated so it is developed into Zero Inlfated Bivarite Ordered Probit Regression (ZIBOPR). This study aims to estimate the parameters of the ZIBOPR model, using the Maximum Likelihood Estimator (MLE) method with Brendt, Hall, Hall, and Hausman (BHHH) numerical iteration. This study produces a parameter estimator of the ZIBOPR model which is a combination of binary probit regression and bivariate ordinal probit regression with the BHHH numerical iteration approach.

Multiresponse Nonparametric Regression Modeling with Mixed Estimator of Truncated Spline and Kernel

Aris Aswadi; I Nyoman Budiantara; Ismaini Zain

Regression analysis is a statistical method used to identify patterns of relationships between one or more variables. In this analysis, there are two types of variables: response variables and predictor variables. Three types of regression that are often developed by researchers are parametric, nonparametric, and semiparametric regression. Parametric regression is used when the shape of the regression curve pattern is known, nonparametric regression is used when the shape of the curve pattern is unknown, and semiparametric regression is used when part of the shape of the curve pattern is known, and another part is unknown. The pattern in question can be linear, polynomial, exponential, or other. In cases where the regression curve is unknown, a nonparametric regression approach is recommended. Some known nonparametric regression models include kernel, Fourier series, local polynomial, and spline. In this study, a mixed model of two different nonparametric estimators will be used, namely the truncated spline and kernel estimators. In addition, this study will also develop a multiresponse nonparametric regression. Multiresponse will accommodate cases where several response variables need to be analyzed simultaneously. Spline estimator, especially truncated spline, has a very good ability to handle data with changing behavior in certain sub-intervals. Meanwhile, the Kernel estimator has a very good ability to model data that has no pattern or shape or even seems random. The research to be developed aims to estimate a multiresponse nonparametric regression model with a mixed spline truncated and kernel estimator. To estimate the multiresponse nonparametric regression model with a mixture of truncated spline and kernel estimators, the two-stage Weighted Least Square (WLS) method is used. In this study, obtained the multiresponse nonparametric regression model with mixed truncated spline and kernel estimator $\hat{\boldsymbol{\mu}}_{(\mathrm{K,T})}(\mathbf{x}, \mathbf{z})$.

Confidence Interval For Parameter Of Biresponse Fourier Series Nonparametric Regression Model

Aulia Rahmah Ramadlana; I Nyoman Budiantara; Ismaini Zain

Nonparametric regression is one of the regression analysis approaches used to see the pattern of the relationship between response variables and predictors of unknown shape. Confidence interval is an important part of statistical inference that is used to determine the predictor variables that significantly affect the response variable. Confidence intervals for parameters on one response variable have been widely used. In this case, we will examine the confidence interval on two response variables. Given paired birresponse data following a birresponse nonparametric regression model $y_{li} = \sum_{j=1}^{p} f(x_{jli}) + +\varepsilon_{li}$, where $\sum_{j=1}^{p} f(x_{jli}), l = 1,2; i = 1,2, \ldots, n; j = 1,2, \ldots, p$ is a regression curve of unknown shape. So it will be approximated by a fourier series function expressed by $f(x_{jli}) = \frac{a_{0l}^*}{2} + b_{lj}x_{jli} + \sum_{k=1}^{K} a_{klj} \cos k\, x_{jli}$. This study will introduce the mathematical expression of the estimator $\hat{\boldsymbol{\gamma}}$ and will then be used to find the confidence interval. The estimator is obtained from Weighted Least Squere (WLS) optimization

$$\min_{\gamma}\{\boldsymbol{\varepsilon}'\boldsymbol{W}\boldsymbol{\varepsilon}\} = \min_{\gamma}\{(\boldsymbol{y} - \boldsymbol{X}(K)\boldsymbol{\gamma})'\boldsymbol{W}(\boldsymbol{y} - \boldsymbol{X}(K)\boldsymbol{\gamma})\}$$

The solution of the WLS approximation produces the estimator $\hat{\boldsymbol{\gamma}} = \left(\boldsymbol{X}'(K)\boldsymbol{W}\boldsymbol{X}(K)\right)^{-1}\boldsymbol{X}'(K)\boldsymbol{W}\boldsymbol{y}$. To construct the confidence intervals of the regression parameters define the pivotal quantity by

$$T_{ljk}(x_1, x_2, \ldots, x_n, y_1 y_2) = \frac{\hat{\boldsymbol{\gamma}}_{ljk} - \boldsymbol{\gamma}_{ljk}}{\sqrt{Var(\hat{\boldsymbol{\gamma}}_{ljk})}} = \frac{\hat{\boldsymbol{\gamma}}_{ljk} - \boldsymbol{\gamma}_{ljk}}{\sqrt{\sigma^2\left(\boldsymbol{X}'(K)\boldsymbol{W}\boldsymbol{X}(K)\right)^{-1}_{cc}}}$$

σ^2 is the population variance whose value is unknown, then estimated by MSE and obtained the pivotal quantity for regression parameters

$$T_{ljk}(x_1, x_2, \ldots, x_n, y_1 y_2) = \frac{\hat{\boldsymbol{\gamma}}_{ljk} - \boldsymbol{\gamma}_{ljk}}{\sqrt{\frac{\boldsymbol{y}'\boldsymbol{A}\boldsymbol{y}}{2n - 2p(k+2)}\left(\boldsymbol{X}'(K)\boldsymbol{W}\boldsymbol{X}(K)\right)^{-1}_{cc}}} \sim t_{2n-2p(k+2)}$$

where $\boldsymbol{A} = \boldsymbol{I} - \boldsymbol{X}(K)\left(\boldsymbol{X}'(K)\boldsymbol{W}\boldsymbol{X}(K)\right)^{-1}\boldsymbol{X}'(K)\boldsymbol{W}$. After obtaining a pivotal quantity, the construction of a confidence interval is expressed in probability $P\left(a \leq T_{ljk}(x_1, x_2, \ldots, x_n) \leq b\right) = 1 - \alpha$. To get the shortest confidence interval using the Lagrange method. So that we get the shortest confidence interval formula (1-α)×100% for the parameter $\boldsymbol{\gamma}_{ljk}$

$$P\left(\widehat{\boldsymbol{\gamma}}_{ljk} - t_{\left(\frac{\alpha}{2};2n-2p(k+2)\right)}\sqrt{\frac{\boldsymbol{y'Ay}}{2n-2p(k+2)}\left(\boldsymbol{X'(K)WX(K)}\right)_{cc}^{-1}} \leq \boldsymbol{\gamma}_{ljk}\right.$$

$$\left.\leq \widehat{\boldsymbol{\gamma}}_{ljk} - t_{\left(\frac{\alpha}{2};2n-2p(k+2)\right)}\sqrt{\frac{\boldsymbol{y'Ay}}{2n-2p(k+2)}\left(\boldsymbol{X'(K)WX(K)}\right)_{cc}^{-1}}\right) = 1 - \alpha$$

(Virtual) Automated reasoning tools for dealing with elementary but intriguing geometric loci
Tomas Recio, Carlos Ueno

A common response to new educational technology is to suggest banning it, arguing that it could replace the development of certain skills and knowledge with the capabilities of the new tool. To counter this argument, it is essential to provide examples demonstrating how the wise use of new instruments can enhance the teaching and learning of mathematical competencies.
In our present contribution, we address the situation described above through an example in Geometry which incorporates the following elements:
a) the automated reasoning tools of GeoGebra Discovery, an experimental version of the mathematical software GeoGebra;
b) the development of mathematical reasoning and proof competencies through elementary geometry problems, such as loci computation; and
c) a concrete geometric construction as triggering event: given a triangle ABC, find the locus of points P such that ∠ABP and ∠ACP are congruent.
This construction can be quickly done using GeoGebra Discovery, but what does "find- ing" mean here? Is it just creating a visual image or finding an equation with coefficients based on the positions of A, B, and C? Our goal is to understand the geometric locus both symbolically and geometrically. As we explore with the help of algebra and geometry software, we'll discover various connections to geometric concepts that will deepen our understanding of elementary geometry.
In summary, our goal is to describe the challenges that arise in this elementary yet highly inspiring and intriguing context, as an example of the methodological protocols and clear advantages associated with new technologies in mathematics education.

On a Study of Improvements of the Quadratic Curves Addition Method: Consideration of Theorem 8
Hideyo Makishita

In a quest to find the centers of circles inscribed or circumscribed by multiple circles, the author has developed a practical and applicable solution- the quadratic curves addition method. This method, which involves the addition of ellipses, hyperbolas, and parabolas to a drawing made with a ruler and compass, is not just a theoretical concept. The author has constructed the quadratic curves addition method with eight theorems, with Theorem 8 being the focus of this study. Its relation to other theorems is discussed, and we will demonstrate its practicality by using Cinderella and Ketcindy to draw mathematically correct figures for Wasan and Sangaku.

(Virtual) Research on the Use of Dynamic Geometry via Blended Learning
Šárka Voráčová

Teaching geometry through a blend of distance learning, IT support, and in-person consultations has proven to be an effective approach. The use of appropriate software allows for personalized learning experiences, replacing traditional knowledge with the development of valuable habits and strategies. Over two years, we

conducted statistical evaluations of students" knowledge and attitudes after utilizing a blended learning method that actively incorporated dynamic geometry software.

(Virtual) Towards a conceptual framework for integrating mathematical digital competencies in digital project-based learning of mathematics
Marc Helton Sua, Lester Hao

In this paper, we will consider the theoretical connections between Project-Based Learning (PBL) and Geraniou's Mathematics Digital Competency (MDC). PBL is generally defined by its constructivist theoretical grounding, where students are expected to answer a big question by forming groups and answering complex questions using knowledge and skills from multiple subject matter. Studies have shown that PBL contains five distinct features: collaborative learning, disciplinary subject learning, iterative learning, authentic learning, and student engagement. An evolution in PBL is Electronic or Digital Problem Based Learning (E-PBL), which grew out of the COVID-19 pandemic and the need to adapt. The researchers seek to enhance E-PBL and its features through the MDC by mapping their main features to each other in an effort to enhance and improve student innovation, creativity, and empowerment. Findings show that E-PBL and MDC intersect on the basis of motivation, instrumentation, and competency. The paper suggests that integrating MDC into E-PBL would be a robust framework that encourages collaboration, research, and innovation towards strengthening techno-mathematical literacy and fluency among students.

Room 5, (Chair: Reggie Nalupa)
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(Virtual) An Initial Analysis on the Reliability of Using Chatbots in Solving Word Problems in Probability
Reggie Nalupa, Lester Hao

This study explores the reliability of using chatbots, primarily ChatGPT-4o and Copilot, in solving word problems in probability. The integration of artificial intelligence in education has transformed instructional methods, offering tools for personalized learning and instant feedback, which are critical for developing problem-solving skills. Chatbots leveraging natural language processing (NLP), simulate human conversations to assist in educational settings. This research focuses on evaluating the accuracy of chatbots in solving probability problems. A comparative analysis approach was employed, wherein probability word problem involving conditional probability were posed to the chatbots. The solutions provided by the chatbots were then compared to the correct solution obtained from reference materials using a specific evaluation criterion. The results highlight the potential and limitations of chatbots in educational applications. While chatbots demonstrated the ability to engage in meaningful conversations and provide correct solutions in some instances, issues such as misunderstanding, complex queries and the necessity for continual algorithm updates were also observed. This study's findings contribute to improving chatbot design and functionality, aiming to enhance educational outcomes and problem-solving skills. By identifying metrics for accuracy, this research provides insights into the potential of AI-powered chatbots as a reliable educational tool.

(Virtual) GeoGebra for Visualizing Mathematical Concepts: Teachers' Narratives on Use of It for Conceptual Learning
Binod Prasad Pant, Niroj Dahal, Bal Chandra Luitel

Integrating information and communication technology (ICT) in mathematics education has been increasingly recognized as a powerful tool for increasing students' interest and performance. It is widely discussed that students' understanding of mathematical ideas is not satisfactory, especially in terms of conceptual understanding. Using narrative inquiry as a research method, we examined the experiences of four secondary mathematics teachers—two men and two women—who successfully integrated GeoGebra while teaching geometry and function, an ICT application, into their regular mathematics classes. These classes typically consist of around 20 students aged 13 to 14 years. Through in-depth interviews and reflective narratives, this study explored the teachers' insights on how GeoGebra transforms the learning environment in school mathematics. The participants reported that GeoGebra significantly advances concept formation by allowing students to visualize and manipulate mathematical ideas and concepts such as geometric shapes and algebraic functions. This interactive engagement clarifies abstract ideas and accelerates students' curiosity and motivation, making learning more enjoyable. Further, participants observed that students are more enthusiastic and willing to engage with challenging mathematical problems when using GeoGebra. The study concluded with recommendations for teachers to use GeoGebra effectively

in math lessons. It advocates for professional development programs to equip teachers with the necessary skills to integrate ICT tools like GeoGebra effectively and suggests avenues for further research to explore the long-term impact of such technologies on student engagement and learning outcomes.

Room 6, (ISIMMED) (Chair: Lusi Harini)
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Bifurcation in Crop-pest-natural enemy Model with Holling Functional Responses and considering Logistic Carrying Capacity
Dian Savitri;Abadi;Hasan Panigoro;Emli Rahmi;Mifta Kharisma Dewi;An Nisa Salsabila

This study aims to develop an ecological model of the interaction between pests and natural enemies of predators in the food chain in the mangrove ecosystem. Mangrove ecosystems play an important role as a habitat for plant and animal species, including pest organisms and natural enemies that play a role in maintaining ecological balance. This predator-pest interaction creates a natural balance that prevents pest population explosions using Holling type I functional responses. There are five equilibrium points, three equilibriums locally asymptotically stable under certain conditions. These predators utilize pests as their primary food source, which directly suppresses the pest population and maintains the stability of the mangrove ecosystem, as evidenced by the emergence of the Hopf Bifurcation phenomenon when $\alpha = 0.00888$. The numerical simulation results also show that Transcritical Bifurcation occurs when $\alpha = 3.531967$, which causes changes in one of the equilibrium points, namely E_3.

High School Students' Self-Regulation through Integration of Design Thinking with STEAM Project Based Learning in Mathematics Learning
Emas Marlina

This project aims to foster self-regulation in high school students' ability to regulate their behavior in acquiring content, skills and academic tasks through the integration of design thinking with STEAM-project based learning in mathematics learning. This concept includes aspects of design thinking through the stages of empathizing, defining, designing ideas, prototypes, and testing or testing based on cognitive and emotional self-regulation and attitudes towards mathematics learning related to their self-efficacy, interests and enjoyment during learning activities. The integration of design thinking with STEAM project-based learning provides attitudes towards self-regulation of high school students within an innovative framework, enhancing creativity, collaboration and communication skills, encouraging critical thinking and iteration, appropriate solutions in facing real-world challenges and making education more enjoyable and inspiring.

The Role of Technology in Enhancing Thinking-Based Learning
Luthfiah Azizah; Saskia Tomigolung; Nurul Kumalasari; Kuswari Hernawati

In the midst of globalization and the industrial revolution 4.0, technological transformation has penetrated various aspects of human life, including education. Contemporary education emphasizes not only the delivery of knowledge, but also the development of critical, creative and reflective thinking skills, in line with the demands of 21st century skills. This research explores the role of technology in enhancing thinking-based learning, highlighting effective technologies, integration strategies and challenges facing educators. Through a systematic review of academic articles, this research identifies the benefits of digital tools and platforms in encouraging critical thinking skills and collaboration among students. Despite challenges such as infrastructure and training needs, findings show that technology significantly enhances the learning experience, encouraging more personalized and interactive education.

Day 3. Tuesday, December 10th, 2024

Session 8: 08:30-09:25

Room 3 (Chair: Setsuo Takato)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

(Virtual) Digital Human Resource Development and Mathematics Education
Norie AOKI, Hideyo MAKISHITA

In Japan, the development of digital human resources is an urgent issue. As part of the Advanced Human Resource Development Project, support is provided at the high school level to improve ICT equipment and dispatch specialized personnel. This paper will propose mathematics education and use ICT to take advantage of the project.

Development of methods for interactive classes using KeT-LMS
Koji Nishiura, Setsuo Takato

We developed KeTpic to simplify the process of producing high-quality graphics in TeX documents. Further, we developed KeTCindy, which serves as an interface between KeTpic and Cinderella dynamic geometry software, and KeTCindyJS, which integrates the functions of KeTCindy to CindyJS, enabling easy creation of various interactive materials. KeT-LMS is an online learning system developed by KeTCindy JS. Online classes have become a common teaching method, but interactivity between students and teachers is important regardless of whether the class is online or face-to-face. In mathematics education, the formula input conversion method is an issue to enable interactivity online. This is because it is difficult for students to send formulas to teachers. Therefore, we defined a simpler formula format based on TeX that we call KeTMath format and added a function to KeTCindy that converts simple formulas to TeX formulas. KeT-LMS allows for the easy creation of HTML for submitting questions and receiving answers based on one-line text in KeTMath format. Students can receive the URL where the HTML is uploaded. Then they create and send their answers in KeTMath format for submission. In this study, we develop effective methods for interactive classes using KeT-LMS.

Room 5 (ISIMMED) (Chair: Syarif Hidayatullah)
Zoom Meeting ID for Room 5: 943 3789 4785
Passcode: atcm2024

(Virtual) Artificial Intelligence in Mathematics Instruction: Challenges and Opportunities for Enhancing Student Learning
Maulana Al Aziz Harahap; Aan Hasanah

This research investigates the potential challenges and benefits of AI in improving student learning in mathematics teaching. The research will be conducted using the SLR (Systematic Literature Review) method by utilizing national and international source articles related to the integration and utilization of AI in mathematics teaching and the improvement of student learning. Through the review step on the revolution of AI application in mathematics teaching, this research will identify things that become beneficial opportunities and things that become significant challenges in the integration of AI in mathematics teaching and the improvement of mathematics learning in students. Furthermore, this systematic literature review research will also discuss artificial intelligence tools that are often used in mathematics teaching and that can commonly have an impact on improving student learning as well as their advantages and disadvantages. Furthermore, this research will also analyze how to overcome challenges to the application of artificial intelligence in mathematics teaching that may hinder the process of improving students' mathematics learning and also analyze the advantages of applying artificial intelligence that facilitates mathematics teaching facilitators in the process of improving students' learning without eliminating the mathematical thinking process in students. Ultimately, this research aims to contribute to the development of AI-integrated mathematics teaching that leads to better student learning outcomes and a more balanced learning environment in today's technology-driven era.

(Virtual) Analysis of ATugmented Reality Utilization in Mathematics Learning Towards the Era of Society 5.0
Syarif Hidayatullah; Kuswari Hernawati

In the 21st century, the use of technology as a learning tool is an important component of education. Rapid advances in the field of information and computer technology also impact the world of education, offering various conveniences and innovations. Augmented reality is assumed to offer significant solutions in learning. Augmented Reality is a technology that incorporates two-dimensional or three-dimensional virtual objects into a real environment. The purpose of this study is to determine the benefits of Augmented Reality

in learning mathematics. The research method used is Systematic Literature Review (SLR). The data collection technique uses secondary data, in the form of documentation, previous research results, books, and supporting articles. This research was compiled by the researcher by combining relevant and up-to-date books and journals according to the researcher's choice. The results show that Augmented Reality provides significant benefits in learning. AR not only makes learning more interesting and interactive, but also helps students understand math concepts more easily.

(Virtual) Literature Review: Ethnomathematics E-Module as a Solution to Increase Students' Interest in Learning

Sri Sance Samberi

This study aims to examine the role of ethnomathematics e-modules in increasing students' learning interest. Ethnomathematics, the expertise of mathematical concepts with local culture, has been proven effective in attracting students' attention and creating a relevant context for learning. Through an analysis of existing literature, this article discusses how the use of e-modules can facilitate more engaging and contextual learning. Data and statistics from various previous studies indicate that the integration of ethnomathematics in the curriculum can increase students' motivation and interest in learning. These findings are expected to provide insight for educators and curriculum developers in designing more effective learning materials. Ethnomathematics e-modules are an innovation in mathematics learning that integrates local culture into open materials. This study aims to explore the effectiveness of ethnomathematics e-modules in increasing students' learning interest. By reviewing various current literature, it is expected to provide a clear picture of the role of ethnomathematics e-modules in the context of education in Indonesia. The results of this literature review indicate that the use of ethnomathematics e-modules can increase students' motivation and interest in learning, as well as strengthen the understanding of mathematical concepts through an approach that is relevant to everyday life.

Room 6 (ISIMMED) (Chair: Ni Luh Ayu Gita)
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(Virtual) Transforming Mathematics: Integrating Digital Technologies in Teaching and Learning

Tara Segaria, Kuswari Hernawati

The transformation of mathematics education in teaching and learning has developed rapidly, influenced by the integration of digital technology. Teachers can utilize technology to create engaging lessons to hone learners' conceptual understanding and critical thinking skills in mathematics teaching materials. This article examines how digital technology is applied in teaching and learning and explains the importance of teacher competencies and training to enable teachers to utilize digital technology effectively in mathematics teaching. This literature review article shows that the integration of digital technology can improve students' knowledge of teaching materials with effective utilization by teachers.

(Virtual) Differentiated Learning: optimization assisted by an interactive platform-based E-LKPD

Tri Andriyani, Ni Luh Ayu Gita Saraswati, Marlina Septiana;Kuswari Hernawati

Differentiated learning is a learning process that strives to create effective and efficient learning by providing equal opportunities for each student to learn according to their interests, learning readiness, and learning profile in order to achieve improved learning outcomes. However, teachers still have difficulties in implementing it. For this reason, the author is interested in conducting a literature review related to the concept of differentiated learning. The writing of this literature review aims to (1) describe the concept of differentiated learning and (2) provide alternative platforms that can facilitate the differentiated learning process. This literature review is sourced from books and scientific articles. From the results of the analysis obtained (1) strategies in differentiated learning, namely, flexible grouping, tiered assignments, and compaction. and (2) E-LKPD based on wizer.me as an alternative in supporting the differentiated learning process.

(Virtual) Systematic Literature Review: Using Google Classroom Media in Maths Learning to Improve Learning Outcomes

Yuliana Dewi, Kuswari Hernawati

The purpose of this study is to synthesize findings from various studies related to the benefits and challenges of using Google Classroom media in mathematics learning. This research uses the Systematic Literature Review method. A total of 6 literature from various databases which resulted in a review of the use, advantages, and disadvantages of mathematics learning media using digital technology. The advantages of using Google Classroom media can simplify teacher work, increase student learning independence, and can improve student learning outcomes. while the shortcomings are limited internet access, inadequate smartphones, lack of understanding in using digital technology.

Room 7 (ISIMMED) (Chair: Elsa Fahira)
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(Virtual) The Use of Technology-Based Learning Media in Improving Students' Understanding of Mathematics Concepts: A Systematic Literature Review

Elsa Fahira; Anis Afifah Kurniati; Kuswari Hernawati

In the current era of globalization, the learning process can be done by applying technology in it. That is the application of technology-based learning media to improve students' understanding of mathematical concepts. This study is an SLR (Systematic Literature Review) study. This review uses the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach to systematically review studies. Because, according to Moher, this systematic review has four stages: article identification, article screening, eligibility review, and inclusion results. From this literature review that uses the SLR approach by collecting many articles, it can be concluded that technology-based learning media can improve students' understanding of mathematical concepts. This statement is supported by the results of previous research related to the use of various technology-based learning media such as geogebra, desmos, and quizizz.

(Virtual) Systematic Literature Review: Improving Mathematical Literacy Skills Through Quizizz Learning Media on Learning Outcomes

Irma Amelia; Tatang Herman

This study aims to improve students' mathematical literacy skills through a quizizzebased learning media approach. The background is the low mathematical literacy skills of Indonesian students compared to other countries, as shown by the PISA test results. Many students still have difficulty in reading, understanding, and applying information in the form of basic mathematics in everyday life. The research method used is Systematic Literature Review (SLR) by analyzing journals within 2019-2024 related to improving mathematical literacy skills through quizizzebased learning media. The results of the review show that the use of quizizz-based learning media can improve students' mathematical literacy skills effectively. Quizizz is able to make math learning more interesting, interactive, and increase student motivation. The conclusion of this study is the importance of developing and implementing quizizz-based learning media to improve students' mathematical literacy skill.

(Virtual) Utilization of Animation-Based Learning Videos with the Animaker Application in Mathematics Learning

Katwan Nurwahyuni; Hani Yupita Salwa, Kuswari Hernawati

The use of digital technology in education, especially in mathematics learning, is becoming increasingly important to create interactive and engaging learning experiences. One effective learning media is Animaker, a platform that allows easy creation of educational animated videos. This article discusses the use of Animaker as a technology-based learning media, which allows teachers to present mathematics materials visually and interactively. Through the literature study method, this study collected data from various sources on the effectiveness of animation media in learning. The results showed that Animaker can increase students' motivation and understanding of difficult mathematical concepts, such as geometry and algebra. Although Animaker offers many useful features, some features require a subscription fee. However, the ease of use and collaboration features make it a very useful tool for teachers in compiling teaching

materials. Thus, the use of Animaker is expected to improve the quality of mathematics learning through better visualization and more innovative learning methods.

Room 3 (Chair: Edward Boone)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

Technology Integration Frameworks in Geometry Education: A Synthesis of Recent Research

FNU Pujiyanto

This synthesis examines technology integration frameworks from empirical research published from 2016-2022 on integration of computer technology (CT) into geometry education across grade levels. We conducted article searches through article database, i.e., Google Scholar and ERIC with relevant keywords. Inclusion criteria focused on peer-reviewed empirical studies combining geometry education, computer technology integration, as well as the availability of technology integration framework. Out of 338 initial search results, 14 articles met the criteria. The results show that there are 10 frameworks, and the predominant technological frameworks used in these time periods is Technological Pedagogical Content Knowledge (TPACK). The technology integration frameworks from selected articles were categorized based on framework categorizations: how students learn with technology, design and evaluation of tools/tasks, how teachers use technology, and how teachers learn to use technology. The majority of frameworks addressed how teachers learn to integrate technology, with nine out of fourteen selected articles. Most studies focused on in-service or pre-service teachers rather than K-12 students. This synthesis reveals framework usage mostly focused on in-service and preservice teachers and highlights gaps in research on frameworks for student learning with technology in geometry.

Bayesian Sequential D-Optimal Sampling Designs for Fractional Partial Differential Equations

Edward Boone, Ryad Ghanam

Researchers are becoming increasingly interested in using Fractional Partial Differential Equation (FPDE) models for physical systems such as gas flows through porous materials. These models rely on the fraction of the differentiation α, which needs to be estimated from empirical data. Experimentation is needed to obtain empirical data where pressures need to be measured at various times, t, from the initial pressure and distances x from the pressure source which produces an output pressure $p(x,t)$. While sampling times are easy to choose when a sensor is in place. Typically, the location of sensors from the pressure source are arbitrarily chosen. This work shows how to design experiments using a sequential design with a base design and sequentially adding sampling design points by finding the optimal sensor locations along x by minimizing D-optimality criteria which is essentially minimizing the of the volume of the variance-covariance matrix of all the parameters. For parameter estimation a Bayesian framework is utilized a sequential design is used to search through the possible locations for the next sensor in the follow up design. Two simple FPDE parameterisations are used to illustrate the method with a base design of six sensor locations and with five additional sensors locations determined sequentially. The simple examples suggest that the parameter values influence the location of the next best sensor location.

Room 6 (ISIMMED) (Chair: Bertha Oktavika Sembiring)
Zoom Meeting ID for Room 6: 981 4615 6137
Passcode: atcm2024

(Virtual) Technology Digital Integration Math Learning: Digital Competence in Mathematics and Digital Competence in Mathematics Teaching -

Anjarwati; Kuswari Hernawati

In the International Proceedings of Mathematics Education (PME), the 47 educational leaders have agreed and emphasized the importance of preparing teachers to teach mathematics with digital technology. The vision of high-quality mathematics teaching is to provide insight into how someone aspires to implement mathematics teaching with technology. In addition to learning about digital mathematics competence, the

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construction of ideas about digital competence of mathematics teaching from teachers' perspective in mathematics learning integrated with technology will also be observed. Therefore, there needs to be a review of mathematics learning that is integrated with digital profiling of digital mathematics competence and digital competence of mathematics teaching. This research is a quantitative research type using a systematic literature research method. The subjects of this research are PME literature, international ZDM articles, and research articles related to the integration of digital technology in mathematics learning. Technology has ultimately become a means that makes it easier for teachers to compile learning tools and increase student activity by collaborating using technology media so that students are expected to be able to understand mathematical concepts more easily and enjoyably.

(**Virtual**) **Digital Technology Role in Managing the Emotional Risk in Mathematics Learning**
Bertha Oktavika Sembiring; Sugiman; Hadi Nur Rahman

Schools and classrooms are no longer physically intimidating; more is needed to ensure students' mental and emotional safety. Besides that, integrating digital technologies has slowly influenced the learning process, including mathematics. This study aims to explore the integration of digital technology in learning and its effect on students' emotions. It is crucial to understand that the impact of digital technology on students' emotions is not inherently positive or negative, but rather depends on how it is used. With the correct principles in serving, digital technology can manage emotional risks in mathematics learning. Therefore, it is our responsibility as educators, researchers, and policymakers to ensure its proper implementation.

Improving Realiability Forecasting Oil Price on Two Common Calenders by XGBOOST
Gumgum Darmawan;Defi Yusti Faidah;Gatot Riwi Setyanto;Mutiara Hanifah;Aulia Hasanah Nur Rahman

The Gregorian calendar, which influences oil consumption in Europe and America through factors such as seasonal patterns, holidays, and economic cycles, has a significant impact on oil demand. Winter, for instance, increases the need for heating, while holidays and weekends can affect travel patterns and energy consumption. On the other hand, the Lunar calendar, predominantly used in Muslim-majority countries, may influence the oil market differently, particularly because these countries are major oil producers. This research aims to model crude oil prices using a machine learning method, namely XGBoost (Extreme Gradient Boosting), to evaluate the impact of each calendar on oil prices. The results show that the Mean Absolute Percentage Error (MAPE) for the XGBoost model in predicting crude oil prices based on the Gregorian calendar is 9.98%, while it is 9.78% based on the Lunar calendar.

Room 7 (ISIMMED) (Chair: Ahmad Yani)
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(**Virtual**) **Development of Android-based AEBR (Educational Application for Building Spaces) on the Material of Building Spaces**
Ahmad Yani; Mey Liasta Trihastina Br Tarigan; Kuswari Hernawati

This study aims to develop and produce interactive multimedia-based mathematics learning media that are valid, practical, and effective so that they can be applied as mathematics learning media on the material of building space. The type of research used is development research or Research and Development (R&D) which refers to one of the learning system design models or approaches, namely the ADDIE model which stands for Analysis, Design, Development, Implementation and Evaluation. For the research subject, namely class VIII students of SMP Negeri 19 Mataram, totalling 18 people. The types of data in this study are quantitative and qualitative data. The research instruments used were media and material validation questionnaires, student and teacher response questionnaires and student learning outcomes tests. The results showed: (1) The validity of the media based on the assessment of media experts and material experts gets an average percentage of 83.7% with the criteria 'very good / very valid'. (2) The practicality of learning media based on student and teacher responses after using the media gets an average percentage of 96.1% which includes the criteria of 'very practical'. (3) The effectiveness of the media based on the results of student learning completeness after using interactive mathematics learning media is 86%. Based on the results of the study, the use of interactive multimedia-based mathematics learning media AEBR can be said to be feasible with valid, practical and effective categories.

(Virtual) Literature Review and Teaching Practice Recommendations: Integrating Desmos Technology in Teaching and Learning Mathematics

Anggun Siska Hamidah; Marta Lucitania Wicahya; Kuswari Hernawati

Desmos is a visual tool that facilitates students' understanding of concepts, especially in mathematics. This study aimed to examine how Desmos is integrated into mathematics education and the impacts it has. The method used in this study was a literature review, which involved collecting articles related to the topic, compiling them into a collection of relevant discussions, and reviewing the main points of the articles. Eighteen articles were analyzed from national and international journals published within the last ten years. The results indicated that Desmos can be integrated into mathematics teaching practices through electronic worksheets called Desmos Classroom Activities (DCA). Integrating Desmos into teaching and learning mathematics has many positive impacts, such as improving students' mathematical representation skills, increasing their interest in participation, and providing students with opportunities to explore the topics being studied. Therefore, this study recommends Desmos as a tool that can be effectively integrated into teaching and learning mathematics.

(Virtual) Forecasting the stock price of PT. Telekomunikasi Indonesia (TLKM) Using ARFIMA-GARCH Model

M. Al Haris; Nufita Nurohmah; Prizka Rismawati Arum; Saeful Amri

The PT. Telekomunikasi Indonesia is a State-Owned Enterprise (SOE) that remains strong in the LQ45 index with the stock code TLKM, making it an attractive choice for investors. Stock investment is chosen due to its unlimited profit potential. TLKM shares experience significant fluctuations, making them difficult to predict. Stock data is time series data calculated based on time intervals and relatively long durations. This phenomenon is identified as a result of the long memory process. This issue can be addressed using the Autoregressive Fractionally Integrated Moving Average (ARFIMA) model to model the long-term time series data. The ARFIMA model assumes that the residuals have a normal distribution, independent properties, and constant residual variance. However, in financial data, residual variance often varies. This can be resolved by forming a residual variance model using Generalized Autoregressive Conditionally Heteroskedasticity (GARCH). The ARFIMA-GARCH model can handle the long memory data phenomenon with heteroskedasticity to enable more accurate forecasting. Based on the analysis results using daily closing price data of TLKM shares from January 1, 2018, to May 31, 2024, the best model obtained is the ARFIMA(1,0.9249187,1)-GARCH(1,1) model. This model produces a small error based on a training MAPE value of 5.65% and a testing MAPE value of 6.04%. This indicates that the model has excellent capability in forecasting the stock price of PT. Telekomunikasi Indonesia.

Session 10: 11:00-11:55

Room 3 (Chair: Muhammad Husein Arafat)
Meeting ID: 934 2373 0830 Passcode: atcm2024

The Role of Educational Robotics in Integrated STEM Learning Towards the Formation of 21st Century Skills

Muhammad Husein Arafat, Cucuk Wawan Budiyanto, Rosihan Ari Yuana, et al.

As a crucial element in Integrated STEM Learning, Robotics plays a vital role in developing 21st-century skills such as communication, collaboration, critical thinking, and creativity. This research aims to (1) analyze how 21st-century skills emerge in integrated STEM learning and (2) analyze how Educational Robotics supports the formation of 21st-century skills in Integrated STEM Learning. The study was conducted at Sekolah Alam Solo Raya, involving primary and junior students. The research method used is qualitative, with learning conducted through Educational Robotics by creating a door security alarm using an Ultrasonic sensor on a Lego Mindstorm EV3 robot. Data were collected through interviews and questionnaires to evaluate the role of robots in learning. Data analysis was performed using Qualitative Content Analysis. The results showed that (1) 21st-century skills emerge in integrated STEM learning by encouraging students to communicate, collaborate, think critically, and create, and (2) Educational Robotics supports the development of 21st-century skills by providing challenges that require cooperation, collaboration, and communication to solve problems. However, students still need to further hone their skills, especially in communication and critical thinking, to achieve a higher level of 21st-century skill development.

The Effect of Using Educational Robotics in Delivering Student Geometry Materials on the Development of Computational Thinking Skills
Cucuk Wawan Budiyanto, Kristof Fenyvesi, Nur Isaini Hanifah, et al.

This study aims to: (1) Determine how the developed robotics devices can facilitate Computational Thinking abilities in Geometry learning, (2) Determine how the ER Lego Mindstorm module developed can facilitate Geometry learning. The research was conducted using a qualitative method with subjects being 4th to 6th-grade students from a nature-based school. The sample was determined using purposive sampling and then selected according to specified criteria. The instruments used to determine the impact of robotic devices used in geometry instruction, and the achievement of aspects of Computational Thinking during learning were observation and interviews. Observation and interviews were analyzed using descriptive and content analysis. Based on the research results, it can be stated that (1) Computational Thinking in geometry learning using robotic devices can be well facilitated, (2) The utilization of the ER Lego Mindstorm Module developed to facilitate geometry learning can be used. The hands-on practice makes it easier for students to understand geometry learning.

(Virtual) The role of self-regulated learning and self-efficacy in learning mathematics based on digital technology in the industrial era 4.0
Putri Rayani; Djamilah Bondan Widjajantì; Rofi Amiyani

Self-efficacy, an individual's belief in his or her ability to complete a task or achieve a goal, is an important psychological aspect of learning, especially in mathematics. In the Industry 4.0 era, digital technology has transformed education by providing various interactive tools and materials that can strengthen students' self-efficacy and self-regulated learning. Self-regulated learning refers to students' ability to manage their learning process independently, including planning, monitoring and evaluating their progress. This technology provides immediate feedback that helps students be more confident in solving complex problems and encourages them to be more involved in regulating their own learning. However, low self-efficacy can be characterized by a lack of motivation, difficulty completing mathematical tasks, as well as anxiety related to using technology, especially for students who are unfamiliar with digital tools. This article discusses the factors that lead to low self-efficacy and self-regulated learning, such as less positive learning experiences, difficulty adapting to new technologies, and lack of support from educators. To address this, this article proposes a solution in the form of learning strategies that strengthen self-efficacy and self-regulated learning through constructive feedback, a supportive learning environment, and a collaborative approach. Through effective utilization of digital technology and appropriate psychological approaches, mathematics learning in the Industry 4.0 era can become more comprehensive, and increase student motivation, and improve academic achievement.

(Virtual) Bibliometric Analysis Of Interactive Presentations In Mathematics (2000-2024)
Adella Irma Wiyanti; Jean Gloria Kamara; Kuswari Hernawati

The utilization of technology as a medium in Mathematics education serves as an effective way for teachers to deliver content in the classroom. Each teacher facilitates student interaction through interactive presentations. A literature review helps estimate the direction of optimal development for interactive presentations and identifies new innovations in Mathematics education. This study employs bibliometric analysis using the keyword "Interactive Presentation in Mathematics Education." A total of 48 journals were obtained from a collection of 854 journals. Among these, three journals received the most citations: the article titled "DeFT: A conceptual framework for considering learning with multiple representations," published in 2006 by Elsevier; the second article, "Interactive multimodal learning environments: Special issue on interactive learning environments: Contemporary issues and trends," published in 2007 by Springer; and the third article, "Active-constructive-interactive: A conceptual framework for differentiating learning activities," published in 2009 by Wiley Online Library
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Selecting of Optimal Knot Points and Oscillation Parameters with Cross-Validation (CV), Generalized Cross-Validation (GCV), and Unbiased Risk (UBR) in Nonparametric

Combined Estimators Truncated Spline and Fourier Series
Shinta Istibsyaroh Umami; I Nyoman Budiantara; Jerry Dwi Trijoyo Purnomo

The nonparametric regression approach is used when the relationship pattern between response and predictor variables is unknown. There are several methods in nonparametric regression, such as truncated splines and Fourier series. In truncated spline nonparametric regression, determining the optimal knot points is highly important and crucial. Similarly, Fourier series nonparametric regression requires determining the oscillation parameter. Choosing optimal knot points and oscillation parameters in the mixed nonparametric regression model with truncated spline and Fourier series estimators significantly impacts the resulting regression curve. Several methods can be used to select optimal knot points and oscillation parameters, such as Cross-Validation (CV), Generalized Cross-Validation (GCV), and Unbiased Risk (UBR). The aim of this study is to examine the CV, GCV, and UBR methods for selecting optimal knot points and oscillation parameters in the mixed nonparametric regression model with truncated spline and Fourier series estimators. The study's findings provide CV, GCV, and UBR formulas that can be used to obtain optimal knot points and oscillation parameters in the mixed nonparametric regression model with truncated spline and Fourier series estimators.

Room 6 (ISIMMED) (Chair: Nina Andrian)
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(Virtual) The Effect of Environment, Social Support and Enthusiasm on Mathematics Learning Achievement
Luthfiana Sholihati Hasanah; Djamilah Bondan Widjajanti; Rofi Amiyani

This study aims to show the effect of environment and social support on math learning achievement. The learning environment at home, at school and in the community has an important role in determining the level of academic success of students. Support from family, peers and teachers also plays a role in students' motivation and ability to face challenges in mathematics. In addition, enthusiasm for learning, which reflects students' level of interest and engagement in the learning process, is believed to have a direct effect on their academic success. This research uses a qualitative approach by collecting and analyzing existing research results using literature study techniques. The results show that there is an influence between the quality of the learning environment and social support on mathematics learning achievement. Positive social support increases students' confidence and enthusiasm, thus having a positive impact on academic achievement.

(Virtual) The Effectiveness of Learning Using Problem Based Learning Model on Numeracy Literacy and Self-Efficacy of Students
Nina Andriani;Syukrul Hamdi;Wahyu Setyaningrum

This research discusses the importance of students' numeracy skills in learning mathematics. This study aims to determine the effectiveness of learning by using the Problem Based Learning (PBL) model on numeracy literacy skills and students' self-efficacy. The research prer-erxperrirmernt designed in a form of ther oner shot caser study. Samples used in the research were the students of the VIII class of SMP Negeri 3 Kalasan, which consisted of 32 students. Data were collected through numeracy literacy test and self-efficacy questionnaire. The results of data analysis showed that Problerm Based Learning (PBL) mode was applied to the teaching of mathematics (pythagorean theorem material) to students of class VIII SMP Negeri 3 Kalasan on numeracy literacy skills and student self-efficacy There is a significant correlation between numeracy literacy skills and self-efficacy.

Room 7 (ISIMMED) (Chair: Ilham Rizkianto)
Zoom Meeting ID Room 7: 976 0547 7176
Passcode: atcm2024

(Virtual) Exploration of Students' Mathematical Ability Levels: A Review of Adversity Quotient Types
Johannes Gultom; Mathilda Susanti; Hadi Nur Rahman

The utilization of Generative Artificial Intelligence in learning today is not only related to the times that must be followed. However, it offers great impact and potential in improving the quality of education. Learning math is often considered a big challenge for many students. The development of technology,

especially the use of generative artificial intelligence, provides an opportunity to overcome the problems faced by individual students and become a support for students in maximizing every result obtained by students in achieving their expected learning outcomes. This article aims to assess the effectiveness and in-depth potential of the use of generative artificial intelligence in mathematics learning. The effectiveness and potential of this use is evaluated through a literature study by highlighting improvements in student engagement, understanding and learning outcomes. The data in this study was sourced from reputable scientific journals, conference proceedings, and other related sources from Science Direct and Scopus. The results showed that Generative Artificial Intelligence provides potential and effectiveness in learning mathematics for students.

(Virtual) Improving analytical geometry learning achievement through a differentiated learning approach based on students' initial readiness

Kuswari Hernawati, Himmawati PL, Atmini Dhoruri, Ilham Riskianto

This study aimed to measure the effectiveness of differentiated learning approach based on students' initial readiness in enhancing learning achievement of analytical geometry. The research method used was a quasi-experiment involving two classes, involving one experimental class that received differentiated learning and one control class that received conventional lectures. Data were obtained through pre-test and post-test tests which were analyzed using the N-Gain test to determine the improvement of learning achievement. The results revealed that the average N-Gain value of the experimental class was 56.12% and the control class was 60.17%, both of which fell into the category of "moderately effective." Although the N-Gain difference of 4.04 was higher in the control class, the differentiated learning approach proved effective in accommodating students' diverse initial readiness. Statistical analysis using Wilcoxon test for the experimental class and paired sample t-test for the control class showed a significance value of less than 0.05, indicating a significant increase in learning achievement in both groups. It can be concluded that the differentiated learning approach based on students' initial readiness can significantly improve learning achievement in analytic geometry. This approach is more adaptive in adjusting the needs and initial abilities of students, making it relevant to be applied to classes with high heterogeneity of student readiness.

Development of Inferential Statistical Literacy Test Instrument for Students in Conducting Hypothesis Testing

Iesyah Rodliyah; I Ketut Budhayasa; Siti Khabibah

This study aims to develop a statistical inferential literacy test for students in conducting hypothesis testing on the material of testing the mean of two populations and interview guidelines. It is expected that the test instrument will be able to describe students' statistical literacy skills with valid instruments. In this study, the instrument was developed in three stages, namely introduction, planning, and development. The validity of the instrument was carried out by three experts with predetermined criteria. The validity results show that each item measured by three indicators of statistical inferential literacy is in the valid criteria but minor revisions need to be made to several aspects according to the direction of the validators. Then to see the statistical inferential literacy skills of students can be obtained from a trial on nine students of the mathematics education study program at Hasyim Asy'ari University. The conclusion is that the statistical literacy instrument developed meets the valid criteria to describe students' statistical literacy skills.

Session 11: 13:00-13:55

Room 3 (Chair: Malini Nageswaran)
Zoom Meeting ID for Room 3: 934 2373 0830
Passcode: atcm2024

Enhancing Visible Learning in Mathematics through AI-Powered Formative Assessment and Feedback

Malini Nageswaran

The term visible learning approach was founded by the education researcher John Hattie (2009) with a simple concept that learning must be seen and as apparent as possible and not assumed. Australian International School Malaysia has implemented the Visible Learning approach since 2016 and today is recognised as the first certified Visible Learning School in the world. Incorporating AI into mathematics education has the potential to revolutionise teaching and learning experiences hence we as mathematics educators of AISM committed to the visible learning approach have used AI to leverage formative

assessment and feedback to enhance our student's learning experiences. PRODIGY is a gamified platform that tailors a learning path that aligns with the students'' needs and ensures that they receive immediate and relevant feedback. PRODIGY is a platform that combines game and learning, supports differentiated learning, and fosters a growth mindset by making learning visible. The real-time data provided by PRODIGY allows teachers to monitor student progress, identify learning gaps, and adjust the teaching strategies accordingly. We conducted a comprehensive study on 86 students from year 7 and year 8 of AISM for one academic term which is approximately 10 to 12 weeks between two groups of class that uses PRODIGY and one without. The results demonstrate the effectiveness of AI-powered learning tools with visible learning outcomes that enhance mathematics learning in middle school students which aligns with the AISM's commitment to innovative and evidence-based education practices. Despite the benefits of AI it is important to recognise that it is just a tool to enhance learning experiences and not to replace the role of teachers.

Mindfulness-Based Approaches to Digital Math Assessments

Nor Rashina Hayrat Ali

Mindfulness-based stress reduction techniques provide social and emotional learning for students. In addition, mindfulness-based activities help to improve behavior and academic achievement. The term "mindfulness" was originally used in the 1970s in the United States by the biologist Jon Kabat-Zinn. Australian International School Malaysia (AISM) has included mindfulness education in its curriculum since 2021 to alleviate the difficulties brought on by the pandemic. Using stress-reduction and reflective practice-encouraging platforms, this strategy uses guided mindfulness sessions before digital math examinations to help students improve self-awareness, empathy, and focus. Digital portfolios like Seesaw assess students'' academic achievement as well as their emotional well-being, and tools like PhET Interactive Simulations provide secure virtual maths labs for concept experimentation. We developed assessments that integrate technology, allowing students to explore the world of maths freely, and fostering positive engagement as they work on their tasks. These mindfulness-based strategies have led to noticeable improvements in students' maths results and their overall stability during assessments, especially senior assessments.

Room 4 (Chair: Jean-Jacques DAHAN)
Zoom Meeting ID for Room 4: 955 6043 6058
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Painting, Geometry: Infinity

Michl Carral

Using Dürer's perspective machine, we explain the concept of the vanishing point and its application by artists. By modeling this machine, we introduce the projective plane and the completion of an affine plane. This allows us to transform one affine plane into another by altering the point at infinity (a line in the first plane becomes the line at infinity in the second plane). Following a descriptive approach on lines and conics, we provide elementary proofs of well-known theorems (such as the Pappus line and Desargues'' theorem) and projective numerical properties of conics, facilitated by this transformation.

Room 6 (ISIMMED) (Chair: Isna Sofiatun)
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(Virtual) Mathematical Resilience and Student Problem Solving in Mathematics Learning: Is There a Relationship?

Diah Nur Hidayati; Ali Mahmudi

Mathematical resilience refers to the ability of students to never give up and have strong determination when learning mathematics, while mathematical problem solving skills are based on the skills of students to solve math problems correctly and systematically according to Polya's indicators. The purpose of this study is to find out the relationship between math resilience and math problem solving skills in students. The method applied in this research is a systematic literature review. The literature sources used were Science Direct and Google Scholar, with data collected from 2014-2024. The data was analyzed with the predetermined inclusion criteria, then filtered again so that it became 10 relevant studies. The results of the literature review showed that there is a positive relationship between mathematical resilience and learners' problem solving ability. Learners with higher math resilience showed better math problem solving skills.

(Virtual) Systematic Literature Review: Patterns of STEM Integration in Indonesian Mathematics Learning

Isna Sofiatun, Ariyadi Wijaya, Hadi Nur Rahman

Many systematic reviews have examined STEM learning trends in Indonesia. However, there needs to be more research on the patterns of STEM integration in mathematics learning in Indonesia, which can help researchers and practitioners map and develop research by integrating STEM in mathematics learning. This research aims to analyze and synthesize current knowledge and practices in integrating STEM into mathematics learning to fill this gap. A systemic literature review was adopted as the research method. Articles were retrieved from Google Scholar, DOAJ, Scopus, and Sinta databases. Eighteen articles met the inclusion criteria to be analyzed and synthesized in detail. The findings of this study indicate that the pattern of STEM integration in learning strategies is most dominant with PjBL, STEM integration with digital media is still rare, the most dominant topic integration is trigonometry, the integration of STEM components is included in the integrated approach, and the integration of variables in STEM research is diverse both cognitive and affective. This study suggests that in the future, with more research integrating STEM with digital media, there is a need for a STEM curriculum review policy from the government so that an integrated STEM approach can be carried out quickly, not just for research purposes, it is necessary to immediately shift the focus of research from conventional variables (learning achievement, learning motivation) to engineering-based variables (computational thinking, digital literacy, and others) to prepare students for STEM careers needed by the international labor market.

Research Trends about Ubiquitous Learning and its Relevance in Mathematics Education

Tanti Listiani; Dhoriva Urwatul Wustqa; Kuswari Hernawati

The purpose of this study is to analyze the development of publications related to the development of Ubiquitous Learning in educational research. The method used in this study is bibliometrics analysis using data analysis on Scopus.com and utilizing R Studio for more detailed analysis. Publication data is collected using the Scopus database to obtain article data in Scopus-indexed journals. Data was obtained from 1771 relevant articles from the 2020 to 2025 range for Ubiquitous Learning. In addition, 10 articles have been produced regarding the relationship of Ubiquitous Learning in mathematics education. The results of the study show that there is a significant development of research in 2021, and the analysis shows that research on Ubiquitous Learning is still a research trend to date. The development of research has increased from 2020 to 2025 with a slight decline but is still a research topic of interest. Through this bibliometric analysis, it is hoped that it can be follow-up research to develop a Ubiquitous Learning-based learning model because currently, technology is getting better, and the use of LMS at various levels of education is starting to be applied. The focus of the search is also on Ubiquitous learning in mathematics education. Articles were selected from 2012 to 2024 because articles that specifically discuss mathematics are still limited.

Room 7 (ISIMMED) (Chair: Hadi Nur Rahman)
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(Virtual) Metacognitive Strategies in Problem-Based Learning: What They Are and How to Implement Them

Salsabila; Djamilah Bondan Widjajanti

Metacognitive strategies are techniques or approaches used to help students understand and control their own thinking processes, including the abilities to plan, monitor, and evaluate their learning. In the context of Problem Based Learning (PBL), these strategies assist students not only in deeply understanding the material but also in enhancing their ability to organize and reflect on how they solve problems independently. This article employs a Systematic Literature Review (SLR) method to identify and analyze the fundamental concepts of metacognitive strategies, their roles in PBL, and effective implementation steps in the classroom. Key components discussed include task planning techniques, monitoring of understanding, and reflection on outcomes. The findings indicate that the application of metacognitive strategies within PBL can strengthen students' learning independence, improve critical thinking skills, and foster their confidence in tackling complex problems. Furthermore, the implementation of these strategies encourages

students to be more active and reflective in their learning processes, contributing to a deeper and more sustainable understanding of the material.

(Virtual) Quality of mid-semester assessment questions in mathematics at Public Junior Secondary School 3 (SMPN 3) Yogyakarta

Hanan

Evaluation is an important thing to do to measure and determine the quality of something. Evaluation is a form of assessing in order to be able to take the right steps for the future. In the education system, evaluation is not only important to see the quality of education, but also to see the extent of the shortcomings of the implementation of learning that has been done before. In addition, evaluation is useful for determining the next steps that must be taken. Midterm Assessment is an assessment carried out to see the success of learning carried out during half a semester. Midterm Assessment is included in summative assessment when associated with the independent curriculum. In summative assessment it is important to know how the quality of the instruments used in the assessment. It may be that if the results of the assessment are not satisfactory, the fault does not lie in the lack of understanding of the students, but lies in the instrument used which is included in the poor category. The main objective of this study is to determine the quality of questions used in the Midterm Assessment at SMPN 3 Yogyakarta. The aspects measured in this study are the validity and reliability of the items, and knowing the index of the difficulty level of the items. This is because the instrument used in the PTS at SMPN 3 Yogyakarta is a multiple choice question of 30 items. This research was conducted using quantitative methods. The results showed 90% of the questions were valid, and the PTS questions were reliable. In addition, 11 questions fall into the medium category and 19 questions fall into the difficult category.

Developing Students' Self-efficacy in Learning Mathematics through Brain-Based Learning

Dian Endang Lestari; Djamilah Bondan Widjajanti

Self-efficacy in learning mathematics is students' belief in solving mathematical problems. This belief plays a vital role in determining students' learning success, especially in facing the challenges that arise when they learn mathematics. However, several research results show that students' self-efficacy still needs to be improved. This article is a literature study related to the Brain-based learning (BBL) model which theoretically has the potential to develop students' self-efficacy in learning mathematics. In principle, BBL is a learning model that pays attention to the way and capacity of the brain. BBL syntax consists of (1) Pre-exposure; (2) Preparation: (3) Initiation and Acquisition; (4) Elaboration; (5) Incubation; (6) Verification; and (7) Integration. Using such syntax, especially in the elaboration and incubation steps, it is very likely that students' self-efficacy will develop.

Session 12: 15:30-16:25

Room 3 (Chair: Gily Aguilos)
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(Virtual) Understanding the Graphical Representation of the Derivative through the Dynamic Digital Technology GeoGebra

Gily Aguilos, Maria Alva Aberin

To learn the concept of derivative, one needs to understand its different representations. One of which is its graphical representation. The graphical representation of the derivative is associated with finding the gradient of the curve or the slope of the tangent line to the graph of the function at a point. Guided by Duval's Theory of Registers of Semiotic Representations together with Bartolini Bussi and Mariotti's Theory of Semiotic Mediation, this study aims to examine how students learn the graphical representation of the derivative using the dynamic digital technology GeoGebra. Specifically, this study wants to answer the following questions: (1) What are the cognitive factors causing students' difficulties in understanding the graphical representation of the derivative? and (2) How does GeoGebra support students in understanding the graphical representation of the derivative? This study followed the grounded theory design. Data were gathered through observations, secondary data collections, interviews, and study sessions with undergraduate calculus students at a university in the Philippines. Data were analyzed using constant comparative analysis involving initial, intermediate, and advanced coding. The results of this study revealed

that students' difficulties in understanding the graphical representation of the derivative were related to their ability to evolve artifact signs into mathematical signs. It involves performing treatments and conversions in the different registers. These are then affected by their background knowledge, critical thinking skills, and visualization. Results also revealed that GeoGebra has features that help students alleviate these difficulties. These features are its capacity to do mathematical computations, display and format objects, and allow users to choose, manipulate, and simulate processes. These features of GeoGebra support students in visualization, sensation, coordination, interaction, pattern recognition, segmentation, and integration.

(**Virtual**) **Conics in virtual reality**
José L. Rodríguez

In this talk we will deal with the generation of conics in space, using the virtual reality software Neotrie VR. We will put special emphasis on the educational part, which will allow our students to build different conics in a dynamic and interactive way, as well as to understand some characteristic properties of them.

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Contextualized Problem-Solving Design with the Help of Interactive Visual Media
Rianti

Problem solving has become important as one of the main objectives of mathematics education. Mathematical problem solving is usually a non-routine problem involving uncommon contexts, concepts, or procedures. There are many strategies to present mathematical problem solving, one of which is by using contextual problems. In addition, in an effort to improve problem solving and attractiveness in the learning process, using interactive visual media has become one of the relevant strategies. this study aims to design contextual problem solving with the support of interactive visual media. This research was conducted using the DDR (Design and Development Research) technique where designs or products are developed and refined through iterative cycles. This research consists of three stages, namely (1) the preliminary stage, namely analyzing the learning materials to be used. (2) the design stage, namely designing the problems that are done along with the steps. and (3) the development stage, namely developing several pairs of contextual problem solving problems with the help of interactive visual media to assist learning.

A Faded Example Task to Develop Algebraic Thinking Skills
Fathurrahman Azhari Putra; Hartono

Algebraic thinking ability is a way of thinking analytically with activities consisting mainly of generalization, namely recognizing shapes and solving algebraic problems. The system of linear equations of two variables is one of the materials in school that requires algebraic thinking skills. However, the results of previous research state that student errors in thinking algebraically in the system of linear equations of two variables are due to the lack of process skills and conceptual understanding that students have. Thus, a task that can help students develop algebraic thinking skills is needed. This article aims to describe the form of tasks with faded examples that help students develop algebraic thinking skills. The method used is analysis and design. The results provided provide a form of tasks with faded examples in the form of forwad-fadding and backward-fadding.

Designing testlet model mathematical literacy questions on measures of central tendency material
Yoyada Nufninu

The testlet test begins with the provision of a stimulus that contains information in the form of images, graphs, etc. which will then/develop several question items related to the stimulus. The complexity of meaning that can be obtained from using testlets in the classroom will provide significant benefits, especially if the items or test instruments developed are related to real-world problems. This study aims to design and develop mathematical literacy testlet model questions on measures of central tendency material for junior high school students in grade VIII. This research uses a 'Design and Development Research (DDR) design, with research steps namely analysis, design and development. At the analysis stage includes the stage of

analyzing class VII on measures of central tendency material. At the design stage includes designing and designing teslet model mathematical literacy questions. And at the development stage includes compiling testlet model mathematical literacy questions on class VII on measures of central tendency material with personal, socio-cultural and scientific contexts. The questions developed contain 3 levels of student thinking, namely knowing, applying, reasoning.

Design of PISA-Like Mathematics Problems for Learning Change and Relationship in Mathematical Literacy

Vidia Amalia Adjis

Mathematical literacy is one of the important competencies in the 21st century which is currently measured internationally through the Programme for International Student Assessment (PISA). The questions in PISA are designed to measure students' ability to solve real-world problems using mathematical concepts. By completing PISA questions, students find it easier to think about how to identify and simplify problems using the information that has been presented. As a result, students are more likely to develop mathematical literacy. This paper aims to describe the presentation of PISA model questions in mathematical literacy, especially on the content of change and relationship in the material of two-variable linear equation systems which are considered difficult topics for junior high school students. In addition, this paper also discusses how to implement this PISA model problem in the classroom. The research method used is design and development research (DDR). This paper found two things, namely 1) Designing examples of PISA model questions; and 2) Validating solution steps to create mathematical literacy. The results of this study provide mathematics teachers with PISA model questions to teach the content of change and relationship on the material of two-variable linear equation systems with various forms of questions given.

Algebra Problem Design: Strategies to Facilitate the Transition from Arithmetic Thinking to Algebraic Thinking

Dwi Syifa Kusumawati

This article discusses the transition from arithmetic thinking to algebraic thinking, identifying the fundamental differences between these two approaches. Arithmetic thinking focuses on the use of numbers and basic operations, while algebraic thinking involves symbols, variables, and more concepts. In this context, the article presents examples of problems designed to facilitate this transition, starting from those that still rely on arithmetic concepts to those that reflect algebraic thinking. By providing a variety of difficulty levels and types of problems, it is hoped that students can gradually develop their understanding of algebra, preparing them to tackle more complex mathematical challenges. Through this approach, the article aims to provide insights and strategies for educators to support students in the mathematics learning process.

Isomorphic Questions on a Three-Tier Test to Identify Students' Misconceptions on the Topic of Ratio and Proportion: Procedure and Examples

Isni Qothrunnada; Djamilah Bondan Widjajanti

Misconceptions on the topics of ratio and proportion are common among students and can hinder their mathematical understanding. Three-tier test instruments are often recommended by misconception experts, but not much thought is given to how questions should be asked to detect students' conceptual errors. The problem is, routine questions do not necessarily detect the presence of student misconceptions. Students' correct answers to routine questions also sometimes do not reflect students' correct understanding always. This study explores questions designed to identify students' misconceptions about ratios and proportions, allowing deeper insight into students' conceptual errors. In this paper, we propose some sample questions to detect students' misconceptions by using isomorphic questions, which present the same concept in varied contexts. We also propose a procedure in using isomorphic questions for the three-tier test.

The Association of Self-Regulated Learning with Quality of Understanding in Mathematics

Sasqia Ulimaz Maghfiroh; Djamilah Bondan Widjajanti

Self-regulated learning is a method of initiative in a person to be able to monitor and control themselves to achieve certain goals. The quality understanding refers to the way something is known basically how well that knowledge is understood. The quality of understanding in this study includes relational understanding and instrumental understanding. This literature review article discusses the association between self-

regulated learning and the quality of understanding in mathematics learning. Our study concludes that the quality of understanding that students have encourages students to set goals, monitor learning progress and evaluate learning outcomes. Students who have a relational understanding tend to be more able to choose and apply appropriate strategies so that they can identify the causes of failure and success of the strategy.

Designing Contextual Mathematics Problems from Descriptive to Depictive on the Probability
Julia Utami Kesuma

This article aims to describe the development of contextual questions from descriptive form to depictive form oriented to higher order thinking skills (HOTS) on probability material. This research uses design and development research (DDR). This method is usually used to study the design and development process. The aim is to provide an empirical basis for the creation of products and tools for both learning and nonlearning activities, and for the creation or improvement of models. This research was conducted to change contextual questions from descriptive form to depictive form on probability material. There are two general categories in DDR based on the type of purpose, including (1) product and tool research, and (2) model research. The DDR process is used as a research framework in developing questions. It involves: 1) Analysis of learning materials; 2) Design of construction questions; 3) Changing questions from descriptive to depictive. The results of this study are contextual questions in the form of depictive on the material of higher order thinking skill (HOTS) oriented probability.

Task Design Based On Students' Creative Mathematical Thinking Criteria On Arithmetic
Musthofa Ulinnuha

The aim of this study is to describe the development of worksheets that can facilitate the criteria for students' mathematical creative thinking skills in arithmetic material.
This research design uses DDR (Design and Development Research). The design of the worksheet will go through three stages of development, namely Analysis, Design, and Development. The design of the worksheet will be associated with the criteria contained in the ability to think mathematically creatively, namely fluency, flexibility, originality, and elaboration.
The Analysis, Design, and Development procedure is used as a framework in research in the development of worksheets. This includes: 1) Analysis of learning materials; 2) Designing task designs and validating solution steps whether they are in accordance with the criteria for mathematical creative thinking; 3) Developing into several examples of tasks that have met the criteria for mathematical creative thinking in order to improve students' problem-solving abilities.
The results of this study provide mathematics teachers with a model of student worksheets based on creative thinking criteria that can improve students' problem-solving abilities.

Learning Design: Integration of Problem Solving and Problem Posing to Improve Students' Mathematical Creativity in SPLSV
Riski Anan Tama

This paper aims to describe the learning design by integrating problem posing and problem solving on students' mathematical creativity.
Methodology - The method used in this research is Design and Development Research (DDR) with a reflection cycle to refine the learning design based on feedback from the initial stage. This methodology integrates problem solving and problem posing approaches as the main strategies to improve students' mathematical creativity on the System of Linear Equations One Variable (SPLSV) material. This learning design focuses on developing creative skills that include fluency, flexibility, originality and elaboration. The researcher starts by designing a problem solving scenario that allows students to generate a variety of solutions based on the given situation. This stage is then followed by problem posing, where students are given the opportunity to generate variations of problems based on the given situation. The use of reflection cycles in DDR allows this learning design to be continuously adjusted based on student and teacher observations and feedback in the early stages of implementation. The purpose of implementing problem solving and problem posing in this learning is to provide learning experiences that encourage students to think creatively in understanding and solving SPLSV problems in depth.
Findings and Discussion - Analysis of the DDR process with two cycles of reflection revealed that the Analysis, Design, and Development (ADP) procedure was used as the research framework in the

development of the learning design. This procedure includes: 1) Analysis of SPLSV materials; 2) Design of problem posing and problem solving activities to improve mathematical creativity without increasing cognitive load; 3) Development of problem solving and problem posing activity pairs to support and enhance students' creativity.

Significance and Contribution in Line with LSM Journal Philosophy - The results of this study contribute to mathematics teachers in the form of a learning design that integrates problem solving and problem posing strategies on SPLSV material. This learning design is designed to increase students' mathematical creativity which has a positive impact on students' understanding and engagement. Through this approach, teachers can more effectively encourage students to think creatively and critically.

Infographic Posters to Empower Growth Mindset in Mathematics Learning
Novi Eriyantika

Purpose and Research Question *- This paper aims to produce a growth mindset poster design that can be applied to math learning teaching sheets. The goal is to maintain and increase learning motivation and encourage more effort to solve the problems given.*

Methodology *- The Design and Development Research (DDR) and reflection cycles implemented showed that the 'Analysis, Design, and Develop' (ADD) procedure was used as a research framework in the development of growth mindset interventions that can be used in mathematics learning worksheets such as: 1) Analysis of needs, design growth mindset related to mathematics, 2) Design an attractive and informative poster design by adding visual elements, the message given contains a narrative by changing the fixed mindset to a growth mindset. 3) Develop which is adjusted to the theme of growth mindset that has been done by previous research.*

Result *- The growth mindset posters created contain themes such as "Introduction to Growth Mindset Principles", "Learning", "Challenges", "Failure", and "effort", "Success". The posters contain characteristic images of the given message. The narrative and visual images are based on and modified from existing growth mindset interventions and theories. The context is about a growth mindset in mathematics learning.*

Conclusion - *The design developed is a growth mindset poster with growth mindset interventions used 1) Neuroplasticity; 2) Learning from mistakes; and 3) Feedback. The poster created must pay attention to the narrative by changing the fixed mindset message to a growth mindset which is proven to improve students' perception of mathematics, reduce anxiety, increase self-efficacy, and encourage higher engagement in solving problems.*

The Conceptual Framework of Learning Trajectory within Educational Games to Augment Mathematization Processes in Three-Dimensional Space
Uluwatuz Zulfa

This research begins by articulating a learning trajectory-oriented conceptual framework in educational games. Hypothetical learning trajectory (HLT) was designed based on the conceptual framework to assist students in constructing three-dimensional shapes. Hypothetical learning trajectory (HLT) packaged in educational games aims to facilitate the mathematization process of students in learning Three-Dimensional Space. The research subjects were seventh grade students and teachers in one of the secondary schools in Yogyakarta. Data collection in the research was carried out using descriptive qualitative methods. The research conducted is part of the Design research developed using the Didactical Design Research (DDR) method. This research consists of three stages, namely didactical situation analysis, metapedidactic analysis, and retrospective analysis. Retrospective analysis was used to link the results of the hypothetical didactical situation analysis with the results of the metapedidactic analysis. The hypotheses that have been tested will be analyzed to determine whether the hypothetical learning trajectory (HLT) has been designed. If the hypothesis goes well, the hypothetical learning trajectory (HLT) will become a learning trajectory or local trajectory.

Problem Solving Questions Using Working Backwards Strategy
Cahyanti Aditama

Problem solving ability is one of the abilities that must be mastered by students. There are various strategies that can be used in problem solving, one of which is the working backwards strategy. This article explores and presents the design of problem solving problems by applying the working backwards strategy. This strategy focuses on framing questions starting from the final solution, allowing students to understand the process and steps required to reach the answer. In this study, the researcher developed a series of problems designed to facilitate students' mathematical problem solving skills using the working backwards strategy.

Design of Math Story Problems with Solve It Instructional Strategy on System of Linear Equations Three Variables in Inclusive Classrooms
Wina Octaviani

Problem solving ability is one of the important aspects that must be owned by students both in learning and daily life. This is in line with the high standards set by CCSS that students must have the ability to reason and apply mathematical thinking to world problems and challenges. It is not easy for students to have and improve problem solving skills, especially students with special needs. It is necessary to provide appropriate and effective treatment to foster problem solving skills. The purpose of this research is to see the effectiveness of the design and development of products in the form of mathematical story problem design with the Solve It! instructional strategy on the material of the system of linear equations of three variables in inclusive classes. The research method used in this research is design and development research (DDR). The product is designed, and tested on students, then evaluated from the results of the trials that have been carried out. The development used in this research is to test at a higher level with the diversity and needs of students in the inclusion class. As well as using PISA-standard math story problems to train students' problem solving skills with simple instructions at each step of the solution. The results of this study provide mathematics teachers with a student worksheet model to teach the system of linear equations of three variables with appropriate strategies to improve students' mathematical problem solving skills in inclusive classrooms.

Leveraging Artificial Intelligence in Instructional Design for Mathematics Learning: A Bibliometric and Systematic Literature Review
Arista Wibowo

This study provides a comprehensive bibliometric and systematic literature review on the application of Artificial Intelligence (AI) in instructional design for mathematics learning. We systematically analyzed a total of 325 articles to identify key contributors, emerging research trends, and significant subtopics in the field. Our findings highlight a notable increase in the number of publications on this topic up to 2024, reflecting the growing interest in AI-based approaches in mathematics education. Using network analysis, we mapped research clusters to explore the relationships between key topics and identify potential avenues for future research. This review contributes to the literature by offering insights into the current state of AI applications in instructional design and mathematics learning, providing valuable implications for researchers, educators, and policymakers aiming to integrate AI technologies into educational practices.

The Role of Multimedia Learning in Enhancing Mathematical Literacy: A Systematic Literature Review and Bibliometric Study
Indra Kurniawan

Multimedia learning, a strategy that integrates auditory and visual components to enhance students' mathematical literacy skills, is the focus of this study. We aim to evaluate the implementation of multimedia learning in mathematics education through the Systematic Literature Review (SLR) method and bibliometric analysis. Our technique involves using SLR as the research data retrieval tool, followed by bibliometric literature processed by VOSviewer and Biblioshiny software. The data analyzed were exported from the Scopus website from 2018 to 2024 as many as 418 documents. The research data analysis technique uses network mapping analysis of VOSviewer results (network visualization) and content analysis in keywords and studies.This article delves into relevant literature to identify trends, methodology, and significant findings from studies that link multimedia use in mathematics education to the enhancement of mathematical literacy abilities. Additionally, we employ bibliometric analysis to showcase collaboration patterns among academics, thematic advancements in multimedia research within mathematics education, and its influence on mathematical literacy. The findings of this study are expected to provide fresh and exciting insights for the advancement of multimedia-based mathematics education strategies and inspire future research in this domain.

Role Playing Game (RPG) in Mathematics Learning for Fostering Student's Growth Mindset
Muhammad Fajar Romadhonni

This article reviews the use of Role Playing Game (RPG) in math learning (game-based learning) to help develop growth mindset in students. The use of Role Playing Game (RPG) in learning math as an effort to make math learning more interactive and fun and easily accessible to students through smartphone and laptop devices. The method of making this Role Playing Game (RPG) uses the Rapid Application Development (RAD) method with stages such as a) needs planning; b) design process; c) development; and d) implementation. This game-based learning media development utilizes the use of RPG Maker MZ application media as the basis for game development. This media development design uses learning materials in mathematics and refers to aspects of growth mindset as themes used in the game, such as a) belief in intelligence; b) views on challenges, obstacles, and failures; c) views on effort; d) acceptance of criticism; and e) views on the success of others. The use of Role Playing Game (RPG) in learning mathematics is expected to help the development of growth mindset in students.

Objectives

- ◈ The eJMT, an international refereed journal, reports technology-based issues in all Mathematical Sciences.
- ◈ The eJMT deals primarily, but not exclusively, with the use of technologies in mathematics and mathematics education research, pedagogy, and mathematics applications.
- ◈ The eJMT reports the most recent applications of technology in pure and applied mathematics and in electronic format, including video and sound.
- ◈ The eJMT publishes the source codes of programs together with submitted paper electronically, so readers can actually continue the experiments.
- ◈ The journal is also a valuable medium for high school mathematics teachers worldwide to discuss effective ways of implementing technology in their teaching.
- ◈ eJMT is an online, open access journal published 3 times a year
- ◈ RJMT is a printed version of selected papers from eJMT and is published twice a year

Areas of interest

Trend 1: Research in Mathematics and its Applications and Mathematics Education with Technology
Trend 2: Instruction in Mathematics and its Applications with Technology
Trend 3: Learning in Mathematics and its Applications and Mathematics Education with Technology
Trend 4: Newly Emerging Technologies and Mathematical Fields