UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | WSoE Wits School of Education

African Chapter of the International Conference on Mathematics Instruction (ICMI) (AFRICME07)

Acknowledging and Addressing Barriers of Mathematics Education for an Inclusive Africa

14–18 July, Johannesburg, South Africa

Hosted by the **AFRICME07 2025**

at the, Parktown, **School of Education, University of the Witwatersrand**

This booklet contains information about the conference, welcome, venue, conference program as well as abstracts.

Welcome!

The University of the Witwatersrand, Division of Mathematics Education, warmly welcomes you to the 7th African Chapter of the International Conference on Mathematics Instruction (AFRICME 7), taking place from 15 to 18 July 2025.
The venue is located at: 27 St Andrews Road, Parktown, Johannesburg, South Africa.

Hosted by the Wits School of Education, in collaboration with the International Commission on Mathematical Instruction (ICMI), AFRICME 7 continues the tradition of bringing together mathematics educators and researchers across the African continent.
First launched at Wits in 2005, AFRICME aims to provide a platform for dialogue, collaboration, and the sharing of research in mathematics education in Africa.
We are excited to welcome the conference back to its birthplace.

The AFRICME 7 programme will feature an engaging mix of keynote lectures, academic paper presentations, symposia, and "How I Teach" sessions.
The focus will be on significant educational developments and current research in mathematics education across Africa.
Participants will have the opportunity to engage with educators and scholars from various parts of the continent and beyond, gaining insights into innovative practices and regional challenges.

The Wits School of Education is part of the Faculty of Humanities at the University of the Witwatersrand and is situated in the leafy suburb of Parktown, Johannesburg.

The conference will kick off with a Mathematics Teachers' Day on 14 July 2025.
Throughout the event, there will be parallel sessions dedicated to the professional development of mathematics teachers.

AFRICME 7 brings together researchers and educators from across Africa and the global mathematics education community.

Enjoy this exciting and enriching experience!

Professor Judah Makonye
AFRICME7, Chair Organising Committee

Acknowledgements
We are deeply grateful for the generous support provided by our funders, without whom this conference would not have been possible:

- The International Conference on Mathematics Instruction (ICMI)
- Research and Innovation Office, University of the Witwatersrand
- Faculty of Humanities, University of the Witwatersrand
- School of Education, University of the Witwatersrand
- Sharp Calculators

We sincerely thank the staff and students of the University of the Witwatersrand for their hard work in preparing and supporting the organization of this event. In particular, we wish to acknowledge:

- Professor Mercy Kazima, University of Malawi, and ICMI liaison to Africme7
- Prof. Judah Makonye (Chair, Local Organising Committee), Prof. Kakoma Luneta (Deputy Chair), Dr. Aarifah Gardee, Dr. Sego Matlala, Prof. Anthony Essien, Dr. Zaheera Jina Asvat, Dr. Jeremiah Maseko, Dr. Puleng Motseki, Prof. Zingiswa Jojo, Ms. Annie Kgosi, Refilwe Marapola, and many others whose names we may not have mentioned.
- Our Chief Secretary, Mrs. Mukhethwa Chabalala
- Our student coordinators, Mr. Siyabonga Mathenjwa and Neo Mokoena
- Highfield Dining Hall staff for their excellent catering
- Wits School of Education cleaning staff for keeping our venues clean
- Thapelo Baadjes for operational support
- Masebole Mike Motimele for AV and IT assistance
- The Business Manager and Finance Office for processing invoices
- Wits ICT for providing reliable Wi-Fi access
- Wits School of Education students and ushers for their dedication and assistance
- Chatterhands Café for partnering with us during the event
- Wits Marketing Department for providing campus maps and conference packs
- PIMD for ensuring our comfort and access to power throughout the conference

Plenary Speakers at AFRICME7
The **AFRICME7 Conference** proudly features a distinguished lineup of leading African and international scholars in mathematics education:

- **Professor Jill Adler**
  University of the Witwatersrand, South Africa
  A renowned expert in mathematics education, Professor Adler's research focuses on equitable teaching practices and curriculum development in diverse educational contexts.
- **Professor Kgethi Phakeng**
  Former VC, University of Cape Town, South Africa
  Professor Phakeng is a celebrated mathematician and education leader, with extensive work in mathematics teacher development and educational transformation in South Africa and across the globe.
- **Professor Mercy Kazima**
  University of Malawi, Malawi and ICMI liaison to Africme7

Professor Kazima's research contributes significantly to improving mathematics instruction and assessment practices across Africa.

- **Professor Agida Manizade**
  Radford University, Virginia, USA
  An influential scholar in mathematics education with a focus on regional and global educational developments.

Some Helpful Information

Please take note of the following important information:

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1. Weather Notice
For delegates traveling from outside South Africa:
Please note that Johannesburg is currently at the end of its winter season. We recommend that you bring warm clothing to stay comfortable during your stay.

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2. Transportation to the Conference Venue
The conference will take place at the following location:
📍 Wits School of Education
27 St Andrews Road
Parktown, Johannesburg
We advise all delegates to use Uber or Bolt for transportation to the Wits Education Campus. These services are safe and widely used in Johannesburg.
There is free Wi-Fi at OR Tambo International Airport, which you can use to request a ride via the app.

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3. Assistance with Transport Apps
If you experience difficulties using Uber or Bolt, please don't hesitate to contact:

- Mukhethwa Chabalala – *+27 72 615 9965*
  (I can assist with requesting transport if needed)
- Mr. Siyabonga Matenjwa – *+27 71 901 0926*

🔒 Staying Safe in Johannesburg

While Johannesburg is a vibrant and welcoming city, please remain cautious and aware of your surroundings. Here are some important safety tips:

- Keep a lock on your check-in luggage.
- Do not display valuables in public; avoid carrying large sums of cash.
- Never leave your bags, phones, or laptops unattended.
- When driving, lock doors and keep items out of sight (e.g., on the floor or in the boot).
- Avoid walking alone at night; move in groups when possible.
- Shopping malls are safe, but always keep your bag zipped, avoid using your back pocket for valuables, and don't leave bags unattended in shopping trolleys.

📞 Emergency Contact Numbers

- Campus Protection Services (on campus): 011 717 4444
- Ambulance: 082 911 or 10177
- Fire Brigade: 10177
- Police: 10111
- 24-hour Helpline (International): 10903

More AFRICME7 –Delegate Information

📶 Conference Wi-Fi

All delegates will be provided with free wireless internet access at the conference venue.

Option 1:
Network: Wits-Guest
Username: 843768
Password: ~4qFc5t6e

Option 2:
Network: WSOE
Username: WsOE
Password: wsoe2022

If there are any changes to these login details, they will be communicated to you during the conference.

📷 Photography & Filming

Parts of the conference may be photographed or filmed as requested by sponsors. If you prefer not to appear on camera, please inform the operator and step out of the frame.

💧 Water

Bottled water (500ml) will be provided twice a day to all delegates.

🍽️ Meals & Refreshments

- Morning and afternoon tea will be served in the Staff Lounge.
- Lunch will be served at the Highfield Dining Hall. Each meal includes a main course, juice, and a selection of fruits.

Ask ushers for directions or refer to the campus map.

☕ **Chatterhands Coffee Bar**
Operated by members of the d/Deaf community (in collaboration with the Wits Centre for Deaf Studies), Chatterhands will be available during the conference.
Please place and pay for your orders each morning at the Chatterhands table.

🥪 **Campus Canteen**
A canteen offering fast food, snacks, and various coffee options is open from 7:30 AM, next to the Linder Auditorium on the Wits Education Campus.

🎉 **Conference Dinner – Wednesday, 16 July**
The official dinner will be held at the Highfield Dining Hall.
Full details will be shared on Tuesday during the conference.

🗓️ **Thursday, 17 July 2025 – Afternoon: Free City Touring**
The afternoon of Thursday, 17 July 2025 has been set aside for free exploration and guided touring of the city of Johannesburg. Delegates will have the opportunity to experience two different local dining options, accompanied by Wits staff and student guides:

🍽️ Option 1: Western-Style Dining at Mike's Kitchen (Heritage House)
Enjoy a relaxed meal in a classic Western-style restaurant located in a historic house.

- 📍 Mike's Kitchen – Heritage House
- 🔗 Visit Website
- Pre-booking is advised, as seating may be limited.

🔥 Option 2: Township Braai Experience at Samaz Butchery & Braai
For those who want to enjoy authentic local cuisine in a township-style braai (BBQ) setting.

- 📍 Samaz Butchery and Braai
- 🔗 Visit on Restaurant Guru

Note:

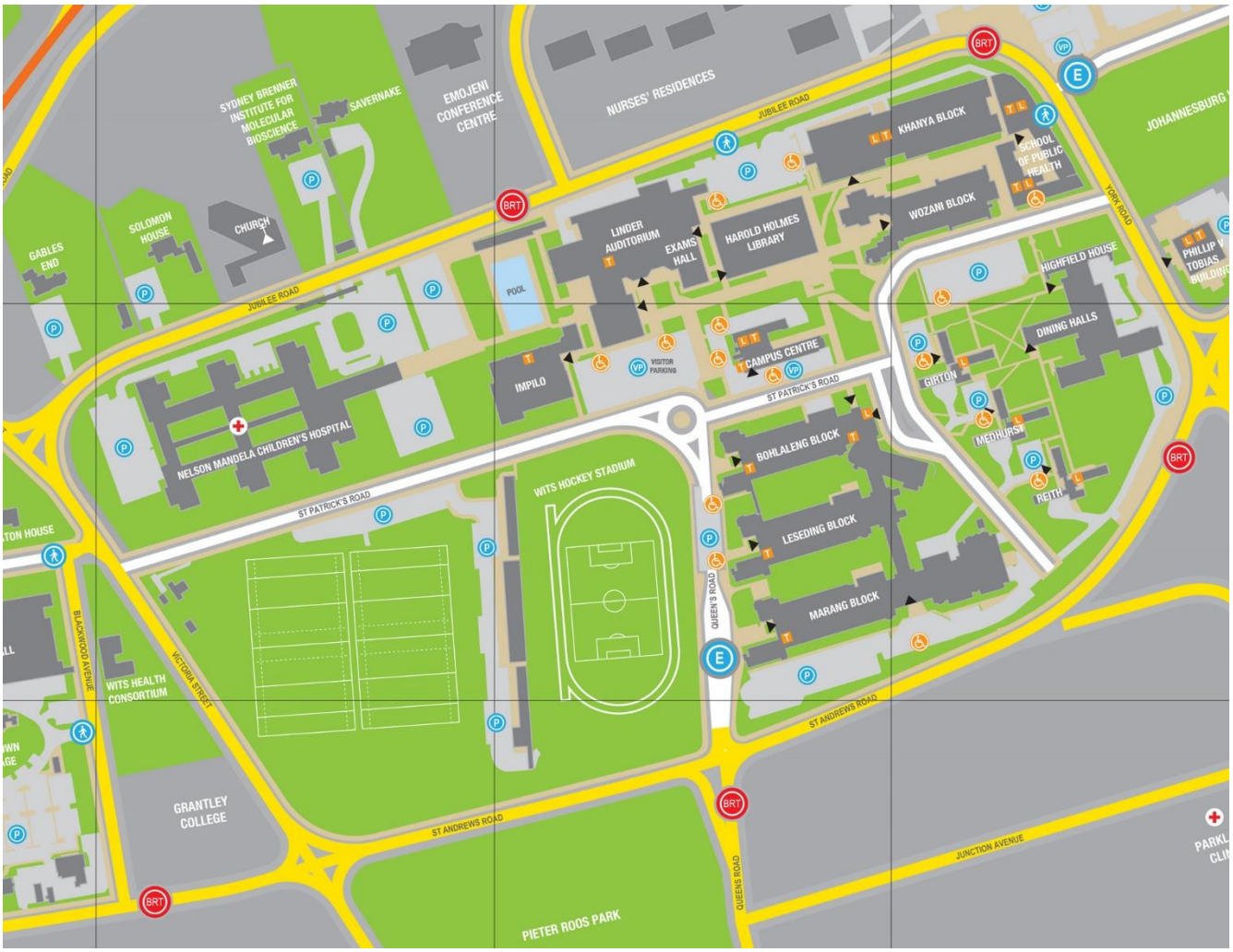
- All meals are at the delegates' own expense, but prices are very reasonable.
- Both venues are close to the conference venue, and guided group visits will be arranged.

We encourage delegates to take this opportunity to unwind, connect, and enjoy the cultural and culinary richness of Johannesburg.

Map of Wits Education Campus

This map is available on:
This is available on https://www.wits.ac.za/maps/education-campus/

School of Education, Wits Education Campus, 27 St Andrews Road, Parktown, Johannesburg. The main entrance is on the corner of Queens Street and St Andrews Road, Parktown.



AFRICME7 venues are on the ground floor of Bohlaleng Block, with plenaries in L101. We will have tea in the staff lounge. A short walk takes you to the Highfield Dining Hall for lunches.

The 7th AFRICAN REGIONAL CONGRESS OF ICMI ON MATHEMATICS EDUCATION (AFRICME7) CONFERENCE
14 July to 18 July 2025
University of the Witwatersrand, Johannesburg, South Africa

Monday 14 July 2025: Teacher Development Day

08:30 – 9:00	**Registration: Foyer STAFF LOUNGE**				
9:00 - 10:30	**STAFF LOUNGE**				
	Opening of the Teacher Development Day AFRICME7 Opening and Housekeeping – **Prof Judah Makonye (LOC_Chair)** **Welcome: Prof Juliet Perumal (Head of the School of Education – University of the Witwatersrand)**				
10:30 – 11.00	**Tea break**				
11:00 – 12:30	**Room B45** **Chair: Aarifah Gardee**	**Room B46** **Chair: Balqis Banjo**	**Room B47** **Chair: Puleng Motseki**	**Room B48** **Chair: Annie Kgosi**	**Room L002:** **Chair: Rina Durandt**
	Mathematics teaching with technologically enhanced support **Jeremiah Maseko**	Challenges and affordances of teaching mathematics in the 21st Century **Kakoma Luneta**	Promoting the development of TPMK in teachers **Sibongile Zulu-Mthembu**	Revisiting Quadratic Equations: Connecting representation and methods **Rencia Lourens & Craig Pournara**	
12:30 – 13:30	**Lunch Break - Highfield Dining Hall**				
13:30-14:45	**B48**				
	Presentation by P. Kimani and L. Watkins In this session, the presenters will facilitate a session focusing on the development of mathematical knowledge for teaching (MKT) among mathematics teachers. They will draw from their experience as mathematics teacher educators and their research on MKT to engage teachers in tasks designed to measure MKT while encouraging reflection on their own MKT and highlighting the impact of MKT on student learning outcomes.				
	Room B45 **Chair: Waseem Patel**	**Room B46** **Chair: Lawan Abdulhamid**	**Room B47** **Chair: Julius Olubodan**	**Room B48**	**Room L002**

				Chair: Nkosinathi Mpalami	**Chair:**
14:45 – 16:15	Using the Mathematics Teaching Framework to design opportunities for deepening understanding mathematics **Craig Pournara & Rencia Lourens**	Improving your maths results with a Sharp Calculator (Primary and High School) **Talitha Moore and A Naude**	CASIO Calculator workshop	Maskew Miller Learning **Thabo Kgosana**	Microteaching Competitions "How I Teach" **B Ed Students from Wits, Durban University Technology and Walter Sisulu University**

TUESDAY 15 July 2025

8: 30-9:00	**Registration - Foyer STAFF LOUNGE**	
9:00-9:30	Welcome to the AFRICME7 Conference **Professor Mucha Musemwa, Dean of Humanities, University of the Witwatersrand**	
9:30-10:30	Plenary 1 – STAFF LOUNGE **A journey of researching mathematics education problems of practice in South Africa** **Jill Adler** **Professor Emeritus, University of the Witwatersrand** This talk traverses my research journey which began in the early 1990s with a study of secondary mathematics teachers' knowledge of their practices in multilingual classrooms and then turned to teachers' professional development, including an exploration of resources in teacher education and of mathematical knowledge for teaching. Each of these foci, in turn, was a function of on-the-ground "problems of practice" related to access to and success in school mathematics in post-apartheid South Africa, with the studies framed by a sociocultural approach to mathematical knowledge, teaching and learning. In my plenary session, I will briefly describe the foci, their rationales and emergence, selected outcomes and their impact on the field. I will close by zooming in to what for me remain open problems, and ongoing research towards their illumination. **Chair: Tony Essien**	
10:30-11:00	**Tea – Staff lounge**	

	Room B45 Teacher Session	Room B46 Chair: Jeremiah Maseko	Room B47 Chair: Esther Kibga	Room B48 Chair: Sibongile Zulu-Mthembu	Room L002 Chair: Marguerite Khakasa Miheso
11:00-11:30		Secondary Mathematics Teachers' Shared Identity: Insights From A Quantitative Analysis Of Participation In A Professional Development Course [LP] **Wanda Masondo & Craig Pournara**	Responding To Instructional Challenges As The Medium Changes: The Usefulness Of Comic Instruction In Science Classroom [LP] **Malakia Haimbangu**	Techniques And Strategies For Preparing Pre-Service Teachers For Digitalized Mathematics Classrooms: Analysis Of Digital Technology Tools [LP] **Annie Kgosi**	Multiple Perspectives on Implementation of Competency Based Education [Sym] **Angel Mukuka, Mary Ochieng, Penina Kamina,. Marguerite Khakasa Miheso and Herine Otieno**
11:30-12:00		Difficulties Experienced By Mathematics Teachers In The Teaching Of Grade 12 Euclidean Geometry [LP][Virtual] **Justin Chidziva & Zingiswa Jojo**	A Review Of Research On Learners' Mathematical Identities [LP] **Waseem Patel & Aarifah Gardee**	Implementation Of Science, Technology, Engineering And Mathematics (STEM). Curriculum In Science Teacher Education In Zimbabwe [LP] **Jeriphanos Makaye & Dominic Mashoko**	
12:00-12:30	Assessing Artificial Intelligence Literacy among Undergraduate Science Education Students: Challenges and Strategies for Improvement [LP] **Maria Tsakeni & Stephen Nwafor**	Exploring The Mathematics Teachers' Beliefs, Attitude And Behaviour (Bab) In ICT Mediated Lessons: A Case Study Of Four Mathematics Teachers [LP] **Victoria Chilengi**	Learners' Mathematical Identities: Ability Grouping Ideologies, Teacher Practices And Other Identities [LP] **Aarifah Gardee**	Grade 12 Examination Performance – Do Calculators Make A Difference? [LP] **Karin Brodie** **Odilo Ndiweni** **Simphiwe Mlotshwa** **Reshma Subbaye** **Renuka Vithal**	
12:30-12:50	Supporting mother tongue-based bilingual education through language-responsive mathematics teaching [SP]	Teaching For Inclusion: The Effect Of Cooperative Learning On Bridging Gender Gaps In Mathematics Performance Among	(Not) Just A "Math Person": A Study Of How Mindset And Motivation Shape Students' Decisions To	Mathematics Teachers Views On The Integration Of Real-Life Situations In The Instruction Of High School	Exploring the Role of Computer Simulations in Enhancing Mathematics Learning Outcomes in a Selected Junior Secondary

	Kate Sehowa, Shemunyenge Taleiko Hamukwaya, Anthony Essien	Secondary School Students In Kenya [SP] **Lydia Ngwiri**	Pursue Mathematics Education [SP] **Emmanuel Iyamuremye**	Mathematics In Tharaka Nithi County, Kenya [SP] **Irene Mutegi Marguerite Miheso-O'Connor Michael Waititu**	School in Narok Central Sub-County, Kenya [SP] **Samuel Ng'ang'a**
12:50-14:00	**Lunch – Highfield Dining Hall**				
	Room B45 Chair: Victoria Chilengi	**Room B46 Chair: Shemu Hamukwaya**	**Room B47 Chair: Jeremiah Maseko**	**Room B48 Chair: Wanda Masondo**	**Room L002 Chair:**
14:00-14:30	Building Primary School Students' Proficiency in Fraction Operation through Fraction Relationships [LP] **Japhet Kwasi Osiakwan & authors**	Enhancing Assessment In Low Resource Teaching Environments: Leveraging Stack In The African Context [LP] **Zevickotieno Juma & Mary Achieng**	Implementation Of Lesson Observation Practice In The Lesson Study Cycle: A Case Of Mathematics Teachers In Chingola District, Zambia [LP] **Tembo Fredson**	Pedagogical Experiences with Assistive Technologies in Mathematics Instruction for Visually Impaired Learners: Navigating Constraints in Under-Resourced Educational Environments. [LP] **Samuel Mashingaidze & Mabuku Shyleen**	Impact Of STEM Policies On Effective Implementation Of Stem Curriculum In Rural Secondary Schools In South Africa [LP] **Rekai Zenda**
14:30-14:50	Harnessing The Epistemic Potential Of Multiple Languages In Transitional Multilingual Mathematics Classrooms In South Africa [SP] **Anthony Essien, Shemunyenge Hamukwaya & Kate Sehowa**	Integrating the Concept of 'Ayatutu' into Mathematics Education: Exploring Collective [SP] **Terungwa Age & Masilo Machaba**	Implementation fidelity and its impact the success of intervention programmes: The case of two mental starters project [SP] **Shemunyenge Hamukwaya, Anthony Essien & Kate Sehowa**	A Case Study of Lean Integrated Teaching Approach in Secondary LOCI Mathematics [SP] **Nickson Mweni**	Showcasing Relationships Between Mathematical Concepts: What Can Be Offered To The Secondary Classroom Pedagogically? [SP] **Ndivhuwo Ndou & Rina Durandt**
14:50-15:20	Trends and Distribution of Primary School Mathematics Teachers' Content Knowledge in South Africa: A	The Impact Of The Foundation Phase Mathematics Curriculum On Developmental Dyscalculia In South Africa [LP]	Teaching And Learning Of Mathematics By Visually Impaired Learners: A Case Study Of Inclusivity In Mathematics	Enhancing grade 12 learners' understanding of rate of change through written activities [LP] **Mamanyena Kodisang and**	Indigenous Knowledge for Boosting Foundational Learning in Sub-Saharan African Countries [LP] [virtual]

	Systematic Review (2005–2025) [LP] **Moeketsi Mosia, Fadip Audu Nannim & Felix Egara**	**Dineo Molise**	Education At Sefula School For The Visually Impaired, Western Province, Zambia [LP] **Kwaleyela Kwaleyela**	**Puleng Motseki**	**Solomon Tesfamicael**
15:20-16:00	**Tea – Staff Lounge**				
	Teacher session B45	**Teacher Session B46**	**STAFF LOUNGE Chair: Samuel Ng'ang'a**		**B46 Chair: Dineo Molise**
16:00-17:30	Errors/Professional Noticing **JP Makonye**	Exploring Representations of Multiplication: A Study in Mozambican Grade 3 Classrooms **Simone Reinhold & Albertina Jorge da Lúcia António**	**Symposium:** Valid and reliable South African tools for identifying mathematics learning difficulties **Discussant: Kakoma Luneta** **Hanrie Bezuidenhout** **Kathleen Fonseca Catherine Nedambale & Gladys Tshikondela**		Mathematical Programming Education: Enhancing Teaching And Assessment With PRIMM In Rwandan Teacher Training Colleges [SP] [Virtual] **Alphonse Uworwabayeho & Solomon Tesfamicael** Integrating ChatGPT With Geogebra For Enhanced Learning Experiences And Computational Thinking Task In Mathematics Education For Secondary Schools Teachers [SP] **Iyamuremye Regis**

WEDNESDAY 16 July 2025

8: 30-9:00	**Late registration - Foyer STAFF LOUNGE**
9:00-10:00	Plenary 2 – STAFF LOUNGE **Language, Power, and Access: Reimagining Mathematics Education in Multilingual Contexts** **Mamokgethi Phakeng** In this presentation I will explore the main challenges in mathematics classrooms created by the interplay between language, power and access as well as the opportunities and possibilities that the challenges present. I will draw on my extensive research on teaching and learning mathematics in multilingual

	classrooms to propose practical ideas that teacher educators, publishers and policy makers can work together on to ensure maximum benefits for mathematics learning for all. **Chair: Sibongile Zulu**			
10:00-10:30	**Tea – Staff lounge**			
	Room B45 **Chair: Kate Sehowa**	**Room B46** **Chair: Nickson Mwen**	**Room B47** **Chair: Hanrie Bezuidenhout**	**Room B48** **Chair: Honorata Kihaga**
10:30-11:00	Mathematics Teacher presentations: A Possible Conceptual Synthesis [LP] **Piera Biccard**	Exploring Representations of Multiplication: A Study in Mozambican Grade 3 Classrooms [LP] **Simone Reinhold & Albertina Jorge da Lúcia António**	Analysing meanings of contextualization through a study of curricular materials [LP] **Anushree Andavan & Shikha Takker**	
11:00-11:30	A systematic review on mathematics in science, technology, engineering and mathematics (STEM) education: 2010-2023 [LP] **Judah Makonye**	Leveraging Technology In Mathematics Teacher Education: Reforming Training For The 21st Century In Tanzania [LP] **Mumbua Ndunda, Felix Kasing'a, Halidi Lyeme**	Errors in Trigonometric Proof-related Reasoning tasks: Insights from Grade 10 learners at a rural school in the Eastern Cape. [LP] **Yamkela Msi; Matome Matsepe & Angel Mukuka**	Engaging Kenyan Prospective Secondary Teachers with Video: Case Studies to Support their Reflection on Pedagogical Practices [LP] **Joanna Masingila, Leonard Kamau, Peter Rugano**
11:30-12:00	Utilizing Mathematics Tasks To Help Pre-Service Teachers Notice The Relevance Of Multiple Representations [LP] **Nkosinathi Mpalami & Matheko Thamae**	Exploring the Role of ICT in Enhancing Science and Mathematics Education in Zanzibar Secondary Schools: A Holistic Approach to Teacher Professional Development and CBC Implementation [LP] **Esther Kibga & Fredrick Mtenzi**	Difficulties In Utilising Innovative Teaching Techniques In Mathematics Classrooms: A systematic review [LP] **Reinhard Selowa and Kakoma Luneta**	The Impact Of Structured Mentoring Program On The Self-Efficacy Of The Newly Qualified Mathematics Teachers In Selected Secondary Schools Of Kabwe District In Central Province Of Zambia [LP] **Hortensia Zulu, Zanzini & Nachiyunde**
12:00-12:20	Operationalising Situations Of Teacher Noticing Of Learner Mathematical Thinking In South African Context [SP]	Use Of Geogebra In Teaching And Learning Quadratic Curves And Its Challenges: A Systematic Literature Review [SP]	The Impact of Combined Teaching Strategies on Students Performance in Large Mathematics Classes [SP]	Effects Of Multimodal Approach On The Development Of Number Sense In Grade 8 Learners [SP] **Moses Kahuli & Helena Miranda**

	Julius Olubodun & Lawan Abdulhamid	Zutaah Puotier & Marguerite Miheso O'Connor	Honorata Kihaga, Bettina Dahl, Septimi Kitta, Morwo Likinjiye	
12:20-13:30	**Lunch – Highfield Dining Hall**			
	Room B45 **Chair: Shikha Takker** Mathematics teachers' perceptions of teaching and assessing students in large classes in secondary schools in Tanzania [LP] **Honorata Kihaga, Bettina Dahl, Septimi Kitta, Morwo Likinjiye**	**Room B46** **Chair: Zutaah Puotier** Primary school teachers' experiences of teaching mathematics using Smartboard technology [LP] **Sheila Madzikanda & Sfiso Mahlaba**	**Room B47** **Chair: Reinhard Selowa** Decolonizing Mathematical Futures: The Role of Artificial Intelligence in Reviving and Repositioning Ethnomathematics in Curriculum Design in Africa [LP] **Terungwa Age and Masilo Machaba**	**Room B48** **Chair: Sego Matlala** Learner Errors as Windows into Mathematical Understanding: Enhancing Teaching through Professional Noticing [LP] **Judah Makonye**
13:30-14:00	Undergraduate mathematics students' understanding of the limit of a function concept: A case of students at a university in Zimbabwe. [LP] **Edmore Mangwende & Aneshkumar Maharaj**	Facilitating A Positive Shift In Students' Engagement With Mathematics: Insights From 21 Maths Camps [LP] **Samuel Okoth Kogalo** **Lucian Talu** **Esther Diera** **Kelvin Barasa** **Michael Chariga** **Mary A. Ochieng**	Early Algebra: Snapshot of Foundation Phase Teachers learning to focus on structure [LP] ***Jacques Du Plessis***	Microteaching Competitions "How I Teach **BEd Students** **from Wits, Durban University Technology and Walter Sisulu University**
14:00-14:30	Leveraging Large Language Models To Identify And Classify Student Errors In Higher Education Mathematics Using The Stack Dataset [LP] **Dogbalou Motognon, Wastalas d'Assise, Otieno Herine**	Effects Of Mathematics Pedagogical Simulation Methods On Mathematics Attainment Of Grade Three Children In Loitokitok Sub-County, Kajiado County, Kenya [LP] **Njaru Mbongo Harrison, Ngaruiya Njoroge Boniface; Inyega Okeo Justus; Thiongo Mwangi John**	*Pedagogical Issues in Mathematics Education and Mathematics Teacher Professional at Primary And High School* ***Esther Kirabo***	
14:30-15:00	Noticing To Know And Inform Action: Using Professional Noticing	Digital Math Activities and Parent-Child Playful Learning with the Early Family Math (EFM) App [LP]	Analysis of Early Grade Teachers' Orchestration of Artefacts in the	Reimagining collaboration: A zone-based analysis of mathematics

	And Error Analysis To Strengthen Mathematics Teaching **Judah Makonye**	**Miheso O'Connor Marguerite** **Herine Otieno** **Feleria Adinda Akumu** **Samuel Okoth** **Lucian Talu Mayabi** **Owen Mulinya Kizito** **Cabrine Nyona** **Zachariah Mbasu** **Emmaculate Odhiambo**	Teaching of Whole-Number Addition in Malawi [LP] ***Fraser Gobede***	teacher educators' learning in Ghana [LP] **Frank Nkrumah & Craig Pournara**
15:00-15:30	**Tea – Staff lounge**			
	Panel discussion **STAFF LOUNGE**		**Professional development for teachers** **B46**	
15:30-16:30	STEM EDUCATION IN ZAMBIA: A MISTY AGENDA **Bentry Nkhata, Kabunga Nachiyunde, Patricia Phiri-Nalube, Zanzini Ndhlovu, Christopher Haambokoma**		Working with the DeBUG Framework to classify geometric reasoning at junior secondary level **Craig Pournara & Shikha Takker**	

THURSDAY 17 July 2025

9:00-10:00	Plenary 3 – STAFF LOUNGE **Professor Agida Manizade** **Plenary Topic:** Evolving Measures of Teacher Knowledge: Geometry, Technology, and Professional Growth in Mathematics Education" Prof. Agida G. Manizade will deliver a plenary session focusing on the development of innovative assessment tools for mathematics teachers' knowledge and competencies. Drawing from her extensive research in geometry education, technological integration, and teacher professional development, Prof. Manizade will discuss how these elements converge to enhance mathematics instruction. **Chair: Kakoma Luneta**			
10:00-10:30	**Tea – Staff lounge**			
	Room B45 **Chair: Jacques du Plessis**	**Room B46** **Chair: Frank Nkrumah**	**Room B47** **Chair: Fraser Gobede**	**Room B48** **Teacher Session**

10:30-11:00	Decompression As A Tool For Promoting Mathematical Thinking [LP] **Shikha Takker & Craig Pournara**	The Use Of Code-Switching In Teaching And Learning Mathematics In Multilingual Primary Schools In South Africa [LP] **Tlangela Mahori**	Considerations For University Mathematics Teachers Through Exploring Students' Prior Knowledge [LP] **Rina Durandt**	Microteaching Competitions "How I Teach **BEd Students from Wits, Durban University Technology and Walter Sisulu University**
11:00-11:30	The Fast Thinkers Game As A Grade 12 Accounting Mathematics Interdisciplinary Teaching And Learning Tool [SP] **Britzz Celeste; Theron Hendri; Rossouw Cobus; Koekemoer Alta; Goodchild Elmarie; Swanepoel Jacobus**	English Only Or Code-Switching For Secondary School Mathematics Instruction? The Views Of Pre-Service And In-Service Teachers [LP] **Lisnet Mwadzaangati**	Exploring The Development Of Technological Pedagogical Mathematical Knowledge (TPMK) In Multilingual Preservice Teachers [LP] **Sibongile Zulu**	
11:30-12:00	Embracing Challenges: The Role Of Productive Struggle In Overcoming Calculus Misconceptions In TVET Settings [LP] **Veli Hlako**	Learners' Perceptions Of Active Learning Strategies In Mathematics: Insights From Selected Schools In Lindi, Tanzania [LP] **Howard Omukami, Winston Massam & Fredrick Mtenzi**	Lessons Learned from Developing an Instrument for Measuring Mathematics Knowledge for Teaching [LP] **Patrick Kimani** **Laura Watkins** **Vilma Mesa** **Rabia Kirikçilar** **Dexter Lim** **Bismark Akoto** **Irene Duranczyk** **Mary BeisiegelBismark Akoto, Irene Duranczyk & Mary Beisiegel**	
12:00-12:20	Exploring the Pedagogical Content Knowledge of Standard 2 Mathematics teachers in Malawi [SP] **Liveness Mwale**	Mathematics Interdisciplinary Teaching And Learning Tool [SP] **Britzz Celeste; Theron Hendri; Rossouw Cobus; Koekemoer Alta; Goodchild Elmarie; Swanepoel Jacobus**	A Back-And-Forth Viewing Of Indigenous-Modern Education For Mathematics Educators And Researchers' Professional Developments [SP] **Yenealem Degu**	
12:20-13:30	**Lunch – Highfield Dining Hall**			

13:30-18:30	**Sightseeing and vists to Mike's Kitchen, St David's Place or Samaz Braai, Yeoville**

FRIDAY 18 July 2025

9:00-10:00	Plenary 4 – STAFF LOUNGE **Improving Teaching and Learning Mathematics in Sub-Sahara Africa: examples from three countries** **Mercy Kazima** **University of Malawi** Teaching and learning mathematics in sub-Sahara Africa has often been described as facing problems, challenges, and limitations. Not much is discussed about the efforts, achievements and successes that are taking place in the region. In this presentation, I will focus on the efforts made by sub-Sahara Africa countries with the aim of improving the teaching and learning of mathematics. I will give examples from three countries: Ghana, Kenya, and Malawi, on the national mathematics reforms that have taken place, the reasons behind the reforms, the achievements so far, further work needed, and the implications. While I acknowledge that there is still work ahead in sub-Sahara Africa, I argue that there are many good efforts, achievements and successes that we need to acknowledge and embrace. Further work should aim to strengthen these while developing other needed areas. I argue further that most of what are referred to as 'problems' of teaching and learning mathematics in our sub-Sahara Africa countries are our contexts and not problems. As the theme of the conference is "acknowledging and addressing barriers of mathematics education for an inclusive Africa", let us also acknowledge and embrace our contexts. **Chair: Mary Ochieng**			
10:00-10:30	**Tea – Staff lounge**			
	Room B45 **Chair: Iyamuremye Regis**	**Room B46** **Chair: Veli Hlako**	**Room B47** **Chair: Liveness Mwale**	**Room B48** **Chair: Lisnet Mwadzaangati**
10:30-11:00	Performance disparities between calculus of motion and non-motion questions in the national senior certificate Examinations, South Africa [LP] **Sego Matlala**	Learners' Conceptual Understanding of The Vertex Form of a Quadratic Function: A Case Of The Vertex And Parabola Concepts [LP]	Teachers' use of mathematical connections for students' conceptual understanding [LP] **Balqis Banjo**	Innovative approaches for developing teacher pedagogical content knowledge for foundational numeracy [PANEL] **Chair: Yasmin Sitabkhan** **Panelists:**

		Wisani Hlangwani, Zwelithini B Dhlamini, and Kabelo M Chuene		**Anthony Essien** **Patrick Iroanya** **Ernest Ampadu** **Wendi Ralaingita** **Mercy Kazima**
11:00-11:30	Mentor vs. supervisor scoring: A study of pre-service mathematics teaching practice differences [LP] **Benita Nel**	Teachers' perspectives on implementing Lesson Study to develop mathematical knowledge for teaching trigonometric functions: A South African case study [SP] **Lancelot Sibanengi Makandidzea**	Imitative and creative reasoning in Euclidean geometry proof tasks within South African Grade 11 mathematics textbooks [LP] **Matome Matsepe & Ugorji Ogbonnaya**	
11:30-12:00				
12:30-13:00	**Closing session – STAFF LOUNGE** **Professor Judah Makonye**			
13:30-14:30	**Lunch and Departure – Highfield Dining Hall**			

Book of Abstracts

Mathematics teachers' use of representations: towards a conceptual synthesis

Piera Biccard
University of South Africa

Abstract

Mathematics teaching relies on the use of representations to convey abstract concepts and facilitate student understanding. However, existing literature lacks a comprehensive synthesis of what constitutes mathematics teachers' knowledge and use of representation. This conceptual study identifies two underlying domains from existing literature: *representational knowledge* and *representational pedagogy*, which collectively contribute to representational mathematics teaching competence or representational pedagogy. Representational teaching competence is categorised into four interrelated and often overlapping dimensions: *visual understanding, visual fluency, connectional understanding,* and *connectional fluency*. Visual understanding encompasses a teacher's ability to connect visual representations to mathematical concepts and distinguish between relevant and irrelevant visual features. Visual fluency extends beyond understanding to seeing mathematical meaning in visual forms and dynamically interleaving representations with various activity types. Connectional understanding emphasises the ability to connect multiple visual representations, explain their similarities and differences, and guide students in making explicit mappings. Connectional fluency, in turn, refers to teachers' flexibility in switching between multiple representations, accessing perceptual chunks, and supporting students in translating between different visual formats. This synthesis provides a structured framework for understanding and enhancing teachers' representational competencies in mathematics education. Implications include teacher professional development programs that target both knowledge and pedagogy.

Keywords: Mathematics education, representation, teacher competence, visual fluency, connectional fluency, pedagogical strategies

Difficulties Experienced by Mathematics Teachers In The teaching of Grade 12 Euclidean Geometry

Justine Chidziva & Zingiswa Jojo

Rhodes University

Abstract

This study sought to identify the difficulties experienced by mathematics teachers in the teaching of Grade 12 Euclidean geometry. Van Hieles' theory of geometric thinking and pedagogical content knowledge were used as the theoretical lens. Following the convergent mixed-methods parallel research design, quantitative data were collected using non-equivalent pre-test-post-test comparison group, while qualitative data were collected using classroom observation and semi-structured interviews. A purposive sample of two Grade 12 mathematics teachers from two different rural schools in a district of the Eastern Cape Province in South Africa, participated in this study. Each of the two participants taught two groups of learners of less than 20 learners each from their school. One of the groups for each teacher was a control group and the other was an experimental group. The quantitative data from the pre-test and the post-test were analysed using the independent samples t-test from the statistical package SPSS while qualitative data were thematically analysed. Results indicated that teachers' effectiveness was hampered by learners' lack of geometric thinking and problem-solving skills, learners' lack of geometry language proficiency and learners' forgetfulness and poor background in geometry.

Keywords: Ubuntu, effective and meaningful teaching, Euclidean geometry, traditional instructional strategies, Van Hiele's theory, Dynamic Pairs Model

Exploring the Role of ICT in Enhancing Science and Mathematics Education in Zanzibar's Secondary Schools: A Holistic Approach to Teacher Professional Development and CBC Implementation

Esther Kibga and Fredrick Mtenzi

The Aga Khan University-Institute for Educational Development

Abstract

Integrating Information and Communication Technology (ICT) into science and mathematics teaching within a Competence-Based Curriculum (CBC) framework is increasingly recognised as a transformative approach for enhancing educational outcomes and equipping learners with 21st-century skills. This study sought to empower educators through a structured, evidence- based professional development program in Zanzibar's secondary schools, where science and mathematics face challenges related to teacher preparedness, curriculum implementation, and student engagement. The project employed a mixed-methods approach, combining quantitative and qualitative research to assess the effectiveness of ICT-integrated teacher training workshops. A total of 951 teachers (234 mathematics, 318 biology, 228 Chemistry, and 171 physics) from Unguja and Pemba were selected through purposive sampling. The intervention included a series of five-day intensive workshops conducted in regional clusters to ensure accessibility. The workshops were designed to enhance teachers' digital literacy, pedagogical content knowledge, and competence in implementing CBC-aligned strategies. The training incorporated hands-on sessions with ICT tools, collaborative lesson planning, and micro-teaching exercises, followed by classroom implementation support and reflection. Data collection involved pre- and post- training surveys, observational checklists during workshops, and focus group discussions with participating teachers. Descriptive analysis of pre-and post-training surveys revealed substantial improvements in teachers' confidence and competence in ICT integration across all subjects. For example, average competence scores in Unguja increased from 58% to 84%, while scores in Pemba North and Pemba South improved from 53% to 80% and 50% to 78%, respectively. Inferential analysis using paired sample t-tests confirmed statistically significant gains ($t = 6.27$, $df = 849$, $p < 0.001$) with a moderate effect size (Cohen's $d = 0.65$). Qualitative analysis of focus group data highlighted increased teacher motivation, practical understanding of CBC, and positive classroom experiences following the training. The results demonstrate that a holistic, ICT-driven approach to teacher professional development can

bridge instructional gaps and foster active learning environments in science and mathematics education. This initiative offers a scalable model for improving STEM education quality, emphasizing the critical role of ongoing teacher training and ICT integration in transforming Zanzibar's educational landscape.

Keywords: STEM Education, ICT, CBC, Holistic Approach, Teacher Professional Development

Engaging Kenyan Prospective Secondary Teachers with Video Case Studies to Support their Reflection on Pedagogical Practices

Joanna O. Masingila, Leonard M. Kamau & Peter Rugano
Syracuse University, South Eastern Kenya University, University of Embu

Abstract

This article describes a collaborative self-study of three teacher educators who formed a community of practice and reflected on and examined our experiences in using video case studies with prospective secondary teachers in Kenya to support the prospective secondary teachers in understanding teaching and learning practices and growing as novice teachers. We took a position of inquiry as stance through our community of practice by forming an inquiry community. Our research objectives were to understand how video cases might be used to support prospective secondary teachers (PSTs) in reflecting on teaching and learning practices as they developed their emerging teaching practices. We used video cases with PSTs in instructional methods courses over two semesters at two public universities in Kenya. The data consisted of teacher educator memos after each class where video cases were used, and transcripts of the audio recording of weekly CoP research group meetings. We analyzed the data qualitatively through open coding and then thematic coding. We report our findings in terms of what we learned about using video cases to support PST learning. We classified our learning about our practice in four areas: (a) prospective secondary teacher responses to using video case studies, (b) the iterative process of using case methods, (c) case methods as a catalyst for changing classroom dynamics, and (d) the demands of using case methods. We discuss four recommendations that we have found enhance the use of video cases.

Keywords: Video case studies; Mathematics Teacher Educator Learning

LEARNERS' MATHEMATICAL IDENTITIES: ABILITY GROUPING IDEOLOGIES, TEACHER PRACTICES AND OTHER IDENTITIES

Aarifah Gardee
The University of the Witwatersrand

Abstract

In this paper, I explore how a Grade 10 mathematics teacher provided learners in a high-performing classroom with opportunities to develop their mathematical identities. I then examine the mathematical identity of one of the highest-performing female learners in his classroom. Findings show that while the teacher offered the learner opportunities to become a full member of his classroom community and engage deeply with mathematics, she did not become a full member of the community due to her negative experiences related to his pedagogy, relationship with her, and the high expectations he placed on her. Instead, she preferred being part of an extracurricular community—the Advanced Programme (AP) mathematics community—where learners were not grouped by ability, and she did not feel pressured by high expectations. Her experiences highlight how ability-grouping ideologies can negatively impact the mathematical identity of a high-performing learner.

Responding to instructional challenges as the medium changes: The usefulness of comic instruction in Science classroom

M. Haimbangu
Ministry of Education, Arts and Culture, Namibia

Abstract

This study aimed to compare the effectiveness of incorporating book- and video-mode comics as instructional materials in primary science classrooms, specifically examining classrooms using the mother tongue and English as mediums of instruction. Additionally, the research sought to explore the experiences and challenges faced by teachers when utilising book- and video-based comic instruction in these two language-varied environments. Employing a concurrent nested design, the study utilised a mixed-method research approach. In the quantitative component, a true experimental design was implemented, involving pre-tests and post-tests administered to a control group and two experimental groups in each participating school. The research included a total of nine teachers from four schools (School S1, S2, S3 and S4) and 90 Grade 4 students from two town schools (School S1 and S4) in the Omusati region of Namibia. Quantitative data analysis utilised Mixed Model ANOVA Type III. The study's findings revealed a statistically significant difference in Grade 4 Science learning outcomes among students exposed to video-mode and book-mode comic instruction, particularly those taught in English, in comparison to those instructed in their mother tongue from Grade 1 to 3. In the qualitative segment, an in-depth interview approach was employed. The data collected from interviews underwent analysis using the inductive content analysis method. The qualitative outcomes irradiated the experiences of teachers concerning the use of comics, addressing challenges encountered by educators and students in the teaching and learning process, particularly in relation to the language of instruction. Participating teachers highlighted a common challenge they encountered when using comics in the classroom, which was the language transition occurring at the Grade 4 level.

Keywords: effective teaching, video-mode comics, book-mode comics, language of instruction, language policy

Panel: Innovative approaches for developing teacher pedagogical content knowledge for foundational numeracy

Chair:

Yasmin Sitabkhan, RTI International

Panelists:

• Panelist 1: Anthony Essien, University of The Witwatersrand

• Panelist 2: Patrick Iroanya, OLICO, University of Pretoria

• Panelist 3: Ernest Ampadu, Royal Institute of Technology-KTH, Sweden

• Panelist 4: Wendi Ralaingita, RTI International

• Panelist 5: Mercy Kazima, University of Malawi

Abstract

Successful mathematics instruction demands that teachers have sufficient content and pedagogical content knowledge. Many teachers in sub-Saharan Africa, particularly in lower primary school, have a weak understanding of mathematical concepts, negative attitudes towards math, and/or low feelings of self-efficacy as math teachers. Panelists will present innovative approaches to strengthening teachers' pedagogical knowledge, which can lead to improved instruction and improved student learning outcomes in the early primary grades and beyond. Approaches include utilizing the Base-Ten Thinking (BTT) framework; using a Whats-App platform to support teachers in building mathematical knowledge for teaching; teacher co-creation of lesson plans; and teacher training modules developed as "global public goods" that are intended to be adaptable across contexts. Each presentation will describe an approach tested with teachers, including findings. Panelists will then discuss questions from the chair and audience, such as lessons learned and opportunities for scaling and/or adapting the approach for other contexts.

Pedagogical Experiences with Assistive Technologies in Mathematics Instruction for Visually Impaired Learners: Navigating Constraints in Under-Resourced Educational Environments.

Mashingaidze Samuel & Mabuku Shyleen
Midlands State University

Abstract

This study examines pedagogical experiences with assistive technologies in mathematics instruction for visually impaired (VI) learners within under-resourced educational environments in Masvingo Province, Zimbabwe. While tools such as talking calculators, tactile graphic displays, and math applications have the potential to enhance learning, their adoption is hindered by systemic barriers, including high costs, limited availability, and inadequate teacher training. Using a qualitative case study approach, the research involved sixty VI learners and three mathematics teachers, selected through purposive and snowball sampling respectively. Findings indicate that assistive technologies improve mathematical comprehension by providing auditory feedback, tactile exploration, and interactive problem-solving. Learners reported increased independence and better understanding of abstract concepts such as geometry and algebra. However, limited access and lack of teacher preparedness hinder their effective integration into classrooms. The study highlights the need for professional development programs and policy interventions to improve accessibility and implementation. Addressing these challenges can enhance learning outcomes and empower VI learners in mathematics education.

Keywords: assistive technologies, visually impaired learners, mathematics instruction, resource-constrained environments.

Digital Maths Activities and Parent-Child Playful Learning with the Early Family Math (EFM) App

Miheso O'Connor Marguerite: Kenyatta University, Kenya
Herine Otieno: EDUHUBAFRIC, Feleria Adinda, Akumu : INNODEMS; Samuel Okoth, INNODEMS, Lucian Talu, Mayabi: INNODEMS, Owen Mulinya, Kizito: INNODEMS Cabrine Nyona: INNODEMS, Zachariah Mbasu: INNODEMS & Emmaculate Odhiambo

Abstract

While research on playful learning in Africa remains in its early stages, most studies focus on non-digital and school-based approaches. This mixed-methods pilot study explores the potential of digital resources to foster parent-child playful learning of mathematics through the Early Family Math (EFM) app, a mathematics learning tool designed for families with young children. The app promotes interactive and engaging mathematical experiences through shared reading, games, puzzles, and investigations, enhancing social interaction between parents and children. Over an eight-week implementation period, the study examined the relationship between Kenyan parents' mathematics anxiety and beliefs about mathematics learning and their engagement with the EFM app's digital activities. A total of 81 parents or caregivers with children aged 2 to 4 years participated across three counties—Nairobi, Kisumu, and Kakamega. Data was collected through baseline and end-line surveys, interviews, focus group discussions, and WhatsApp group interactions. Findings indicate that the EFM app positively influenced parental involvement in playful learning, strengthening parent-child bonds and enhancing parental understanding of their children's mathematical abilities. Parents reported that the app made mathematics learning more engaging and enjoyable, providing children with a platform to explore and express themselves freely. Additionally, the study highlights the potential of digital tools in supporting effective parental engagement—a key component of Kenya's Competency-Based Education (CBE)—while contributing to the broader discourse on play- based learning and digital education in early childhood. This research adds to the growing body of knowledge on digital playful learning in Kenya, emphasizing the role of technology in fostering early mathematics literacy and parental involvement in education.

Keywords: Family Math (EFM)App, Playful learning, Digital learning, competency- based

Mathematics Teachers Views on the Integration of Real-life Situations in the Instruction of High School Mathematics in Tharaka Nithi County, Kenya

Irene Mwende Mutegi , Marguerite Miheso-O'Connor, Michael Muchoki Waititu
University, Kenya

Abstract

The use of real-life events is one of the techniques that has been recommended in the instruction of Mathematics teaching to improve learners' conceptual knowledge. This paper is drawn from a study that was carried out to determine the effects of integration or real-life situations in the instruction of mathematics. Mathematics teachers' opinions on the use of real-life situations in teaching mathematics in Tharaka Nithi County, Kenya has been captured. A closed-ended questionnaire was used to collect data from six mathematics teachers who participated in the quasi-experimental research by teaching the control and experimental groups. The target population was Mathematics teachers from public secondary schools in Meru-South sub-County, Kenya. The study findings showed that teachers of Mathematics are aware of the usefulness of contextual teaching of Mathematics. The breadth of the curriculum and inadequate training were revealed as the impediments to the use of real-life situations in the teaching of mathematics. To improve the effectiveness of real-life situations integration in Mathematics instruction, the study recommends in-service training for practicing teachers, and incorporation of real-life teaching content in teacher training programs.

Cultural game-based learning in mathematics for boosting foundational learning in Sub Sahara African Countries

Solomon Tesfamicael
Norwegian University of Science and Technology, College of Education, University of Rwanda, African Centre of Excellence in the Teaching and Learning of Mathematics and Science

Abstract

This paper aims to discuss the impact of indigenous knowledge on foundational learning (FL) using Culturally Based Game Learning (CBGL) in Sub-Saharan African (SSA) countries. An ethnographic approach, which allows for the use of different data collection methods, including observation, interviews, field notes, document analysis, and video recordings, was employed to study the Igisoro and Gebeta board games found in Rwanda and Ethiopia, respectively. These board games are not unique to these countries but are found across SSA countries in various forms. The findings show that the culturally available games can foster competencies of foundational learning such as numeracy, literacy, social and emotional skills, critical thinking, and digital literacy, demonstrating the potential of indigenous knowledge in boosting foundational learning at a low cost, since the cultural games are easily accessible across the sociocultural contexts in the region. However, research shows that there is a lack of deliberate and systematic efforts to integrate CGBL into the formal school system.

Keywords: Foundational learning, Game-based learning, indigenous knowledge, Cultural Game-Based Learning

Integrating ChatGPT with GeoGebra for enhanced learning experiences and Computational Thinking tasks in Mathematics education for secondary school Teachers

Iyamuremye Regis

Kenyatta University

Abstract

ChatGPT is a chatbot that could be beneficial for education, especially in improving skills related to computational thinking such as programming, debugging, and algorithmic thinking for Mathematics teachers. While ChatGPT shows promise, there is lack of research on its specific role in facilitating the incorporation of computational thinking into Mathematics teaching and learning, particularly through tools like GeoGebra. The researcher integrated computational thinking into Mathematics lessons by incorporating the use of GeoGebra, an application that involves teachers entering commands to create Mathematical objects. In this study, the researcher utilized an educational design research (EDR) methodology to integrate ChatGPT into Math+CT lessons, aiming to help Mathematics teachers to complete tasks effectively. The researcher deliberately selected Mathematics teachers as participants and gathered data by observing their interactions with ChatGPT during Math+CT tasks, recording their conversations and screen interactions. We used a descriptive qualitative method to analyse the data, focusing on the participants' prompts, final codes, and the frequency of iterations. The researcher explored the ways in which ChatGPT could support participants in composing GeoGebra commands, considering both its advantages and drawbacks. Most participants were able to successfully complete the task with ChatGPT 's assistance, requiring only a basic understating of GeoGebra commands, Mathematics and critical thinking. However, the study showed that participants were not effectively utilizing prompts when interacting with ChatGPT. Participants may face challenges in training ChatGPT or engaging in discussions with it due to a lack of grasp on fundamental GeoGebra commands and Mathematical concepts. This research contributes to the current body of knowledge by demonstrating that ChatGPT can support crucial computational thinking elements such as programming and debugging, within the realm of Mathematics education. This indicates that AI tools like ChatGPT have the potential to foster the growth of self-reliant problem-solving abilities, offer customized assistance according to each teacher' s requirements, and enrich personalized learning journeys.

Keywords: ChatGPT, Computational Thinking, Educational Design Research, GeoGebra, Mathematics Education

Investigating a variation in evaluation scores assign by mentor teacher and the university supervisor during teaching practice of pre-service Mathematics students

Nel, BP
University of Western Cape

Abstract

This article investigated the reason for the disjuncture between scores assigned by university supervisors and mentor teachers where the mentor teachers scored the pre-service student eight to ten percent higher than the supervisor for the same Mathematics evaluation lesson. The research question investigated was: Which factors contribute to a difference in the evaluation scores assigned to Mathematics student teachers by school-based mentor teachers and university supervisors during the same lesson using the same assessment rubric? Secondly, how can this difference be narrowed? The participants were purposively selected where final-year Mathematics student teacher with a score difference of eight percentage and more between the mentor and supervisor were selected. Their supervisors and the available mentor teachers were also selected. Open-ended interviews were used to collect the data where some of the interviews were conducted online. The factors contributing to the difference in the evaluation scores of supervisors and mentors included the practice of not having joint feedback sessions and not giving feedback timeously after the lesson has been observed.

Keywords: Pre-service Teachers; Teaching practice; Assessment; Mathematics; supervisor; mentor teacher.

Teaching for Inclusion: The Effect of Cooperative Learning on Bridging Gender Gaps in Mathematics Performance among Secondary School Students in Kenya

LYDIA KARIMI NGWIRI

Abstract

This study explored the influence of gender and instructional method on students' academic performance in Mathematics, with a focus on the Students' Teams and Achievement Divisions (STAD) cooperative learning approach. This objective specifically sought to determine whether there were statistically significant differences in Mathematics performance between male and female students following the integration of STAD cooperative learning method. Using a quasi- experimental design, students were divided into experimental (using STAD cooperative method) and control (not using STAD cooperative method) groups. A null hypothesis was tested, proposing no significant gender-based difference in Mathematics performance. Descriptive statistics indicated that both male and female students in the experimental group significantly outperformed their counterparts in the control group. While female students in the cooperative group recorded a slightly higher mean score (76.82) than their male peers (72.68), a two-by-two factorial ANOVA revealed that gender alone did not have a significant effect on Mathematics performance ($F(1,193) = 1.793$, $p > 0.05$). However, the STAD cooperative learning method showed a highly significant main effect on Mathematics performance ($F(1,193) = 885.305$, $p < 0.05$), explaining approximately 81.9% of the variance. With a p-value of less than .05, the results were statistically significant, providing strong evidence that the treatment group outperformed the control group in Mathematics. The findings from this study confirmed that the Student Teams Achievement Divisions (STAD) cooperative learning method is equally effective for both male and female students in improving academic performance in Mathematics. This study is significant as it demonstrates that the Student Teams Achievement Divisions (STAD) cooperative learning approach fosters gender inclusivity, with male and female students achieving similar performance in Mathematics. The findings challenge common gender-based stereotypes regarding learning capabilities. Addressing gender in this context enriches the broader academic discourse on inclusive pedagogical strategies that aim to provide equitable learning opportunities for all students, regardless of gender that support all learners.

Grade 12 examination performance – do calculators make a difference?

Karin Brodie, Odilo Ndiweni, Simphiwe Mlotshwa, Reshma Subbaye & Renuka Vithal

University of the Witwatersrand, University of Fort Hare, University of Kwa-Zulu Natal

Abstract

The role of scientific calculators in learners' performance on their final Grade 12 examinations has not been studied in South Africa, despite research which argues that calculators are important for teaching, learning and assessment. We analysed the National Senior Certificate examination papers from 2015 to 2020 and showed that learners with scientific calculators who know how to use them may be advantaged by about 15-20 percentage points in these examinations. We then asked a group of 175 Grade 12 learners in a poorly-resourced district in the Eastern Cape, to write to examination papers, one with and one without a scientific calculator. We showed statistically significant increases on the paper written with a calculator, on the overall mark and on six out of the eight comaparable questions. These results apply to learners with higher rather than lower marks. We argue that these results suggest that national or provincial provision of scientific calculators to schools in poorly-resourced districts could benefit both individual learners and the system as a whole.

A REVIEW OF RESEARCH ON LEARNERS' MATHEMATICAL IDENTITIES

Waseem Patel & Aarifah Gardee
University of the Witwatersrand

Abstract

This paper presents a recent review of empirical research on learners' mathematical identities. Eight articles were analysed by integrating three frameworks. These frameworks are Gardee and Brodie's (2021) mechanisms of identity, Akkerman and Meijer's (2011) dimensions of identity and Bronfenbrenner's (1994) ecological model of human development. Following a deep analysis of the papers using these three frameworks, we discuss how research has addressed key critiques from previous reviews regarding the definitions of learners' mathematical identities. In addition, we highlight the theoretical and empirical gaps in research, particularly in relation to the stability of identities over time, the relationships between learners' mathematical identities and other kinds of identities that they construct and the influence of various social factors on the development of learners' mathematical identities.

Building Primary School Students' Proficiency in Fraction Operation through Fraction Relationships

Japhet Kwasi Osiakwan, Mavis Okyere & Foster Danso Ntow
University of Cape Coast

Abstract

Mastering fraction operations remains a significant hurdle for many primary school students, often due to a lack of understanding of the relationships among fractions. This pre-test post-test quasi- experimental study examined how teaching relationships among common fractions enhances primary school students' proficiency in fraction operations and problem-solving skills. Data were collected from 312 basic school students using a pre-post assessment design. Paired t-tests and regression were used to analyse the data collected. The results revealed that students initially struggled with understanding fraction operations. However, post-intervention results demonstrated significant improvements. Moderation analysis revealed that unit fraction recognition and familiarity with fraction names negatively moderated the relationship between understanding of unit fractions and students' proficiency in fraction operations. These findings suggest that rote familiarity with fraction terminology does not necessarily translate into deeper mastery of fraction operations. The study concluded that teaching fraction relationships is effective in improving students' proficiency but should be coupled with instructional strategies that promote deeper conceptual engagement.

Keywords: proficiency in fraction operations, relationships among fractions, conceptual understanding, unit fractions recognition

Lessons Learned from Developing an Instrument for Measuring Mathematics Knowledge for Teaching

Patrick Kimani, Laura Watkins , Corvallis, OR, Vilma Mesa, Rabia Kirikçilar, Dexter Lim, Bismark Akoto, Irene Duranczyk, Mary Beisiegel & Ann Arbor University of Michigan, University of Minnesota, United States, University of Minnesota, Oregon State University, Glendale Community College

Abstract

Significant research has contributed to what we know about the mathematical knowledge needed to teach mathematics in elementary and middle school, how to measure this knowledge, and its positive relationship with student performance in mathematics. Researchers have shown that instruments designed to assess mathematical knowledge for teaching (MKT) in one context (e.g., middle school teachers in North America) are not appropriate for measuring MKT in another context (e.g., post- secondary instructors). In this paper, we share lessons our project learned in the process of creating one such instrument for community college (CC) faculty teaching college algebra. By analyzing records of our instrument creation process, we identified three lessons we learned that others could use when engaging in creating an MKT instrument for advancing students' performance in their context.

Keywords: Mathematical knowledge for teaching, tasks of teaching, community college, college
algebra, choosing problems, understanding student's work, instrument development

SOCIO-CULTURAL BASED MATHEMATICAL LEARNER IDENTITY AND STUDENT PERFORMANCE IN MATHEMATICS

Nickson Tsofa Mweni,
Kenyatta University

Abstract

The article shares findings from a study aimed at establishing the influence of socio-culturally based Mathematical learner identity on student achievement in Mathematics. The sociocultural theory of learning formed the theoretical framework. The study employed a correlational research design with a sample size of 100 students, using the Researcher Introspection Tool and the Student Mathematics Achievement Test to collect both quantitative and qualitative data. Content analysis quantified socio-culturally based Mathematical learner identity data before correlating it to the student performance in Mathematics. The study indicated that socio- culturally based Mathematical learner identity influences student achievement in Mathematics. The analyzed data were then presented in narrative and tabular forms. The study recommends designing constructive artefacts to develop problem-solving activities and the meanings of mathematical concepts.

Keywords: Cultural Artifacts, Mathematics Achievement, Mathematics Education, Mathematical
Learner Identities, Sociocultural Theory

English only or code-switching for secondary school mathematics instruction? The views of Pre-service and In-service teachers.

Lisnet Mwadzaangati
University of Malawi

Abstract

In this paper, I explore Malawian pre-service and in-service teachers (PSTs and ISTs) views about the language for teaching secondary mathematics. Qualitative data was generated from 51 PSTs and 11 ISTs through focus group interviews, transcribed and analysed thematically. The findings revealed that the choices for the PSTs who do not have experience in teaching mathematics were driven by the limitations of home languages, the language policy and the lack of knowledge for using code-switching in multilingual classrooms. Although the PSTs and ISTs who are experienced in teaching mathematics either at primary or secondary level preferred to code-switch, they reported several challenges which also reflected their lack of knowledge to code-switch effectively in multi-lingual classrooms. The lack of inclusion of code-switching in the language policy might indeed render code-switching a tool of promoting inequalities and posing hindrances to teaching and learning of mathematics instead of being a solution for addressing language challenges.

Keywords: home languages, English language, code-switching, pre-service teachers, in-service teachers.

Teachers' perspectives on implementing Lesson Study to develop mathematical knowledge for teaching trigonometric functions: A South African case study.

Lancelot Sibanengi Makandidzea
University of Pretoria

Abstract

Lesson Study (LS) is a classroom-based professional development approach coined in Japan. It was popularised by Stigler and Hiebert (2009) in their book; 'The teaching gap'. Thereafter, many countries started to adopt and adapt LS. In South Africa, LS was introduced by JICA in collaboration with University of Pretoria and Mpumalanga Department of Education. The popular LS model in South Africa has five stages which are as follows: diagnostic analysis; collaborative lesson planning; lesson presentation and observation; post lesson reflection, and lesson improvement (Sekao &; Engelbrecht, 2021) This qualitative study explored teachers' perspectives on implementing LS to develop mathematical knowledge for teaching trigonometric functions (TFs). Six teachers were observed during collaborative lesson planning, teaching, and reflection on three lessons. They were group interviewed on their experiences. Data was analysed using Altas.ti and Braun and Clarke (2006) six phased thematic analysis method. The Mathematical Knowledge for Teaching Framework by Ball et al. (2008) was used to interpret the data. During interviews, teachers reported that they benefited from collaborative lesson planning by: learning new methods of teaching TFs; understanding concepts like amplitude and how they are calculated; learning that TFs are better taught by handling one parameter at a time before combining them to avoid over-planning; learning to differentiate periodicity of the tangent graph and the sine and cosine graphs. Their perspectives on collaborative lesson planning are synonymous with the development of Knowledge of Content and Teaching (KCT), Specialised Content Knowledge (SCK), and Knowledge Content and Students (KCS) through dialogical interactions. The outcome agrees with the findings by Gutierez (2019) that collaborative lesson planning brings content and pedagogical scaffolding and improves teaching skills and professional relationships. (Adler, 2002) Teachers' utterances revealed that lesson presentation and observation sessions benefited them in the following ways: gained confidence and discovered the strength of Desmos software in presenting and teaching graphs; learnt importance of using appropriate wording when defining concepts to learners;

gained content knowledge and teaching skills while observing lessons; appreciate the importance of prior knowledge; learnt how to handle learners' responses. My findings concur with Druken (2023) that teachers learn and gain confidence in teaching new aspects of the syllabus through active engagement in LS rather than just passively reading them. Teachers asserted that post-lesson reflections helped them to improve from lesson 1 to lesson 3. I argue that teachers' responses illuminate development of KCT, SCK and KCS, which acquiesces with Proctor (2019) assertion that teachers develop mathematical knowledge for teaching when they blend their understanding of subject matter.

Keywords: trigonometric functions, Lesson Study, planning, lesson presentation, post-lesson reflection

LEARNERS' PERCEPTIONS OF ACTIVE LEARNING STRATEGIES IN MATHEMATICS: INSIGHTS FROM SELECTED SCHOOLS IN LINDI, TANZANIA.

Omukami Howard, Winston Massam & Fredrick Mtenzi
Aga Khan University, Institute for Educational Development

Abstract

The implementation of a Competence-Based Curriculum (CBC) in Tanzania necessitates pedagogical shifts to enhance learning outcomes, particularly in Mathematics. This study explores learners' perspectives on CBC active learning strategies used by teachers in Mathematics lessons in Lindi, Southern Tanzania. A total of 104 learners and 6 in-service teachers from 2 primary schools were purposively sampled due to their exposure to CBC-focused professional development initiatives. Using a quantitative descriptive survey design, data was collected through structured questionnaires and analyzed via frequency counts, percentages, and T-tests for proportions. Findings indicate that 80% of learners believe active learning strategies are feasible, while 94.87% can identify their usage in teaching. Furthermore, 47.2% recognize challenges faced by teachers in implementing these strategies. Statistical analysis using T-tests revealed significant differences between the two schools in learners' ability to link active learning with competence-based learning ($p < 0.001$) and ease of learning with active learning strategies ($p = 0.04$). However, no significant differences were found regarding teachers' use of active learning strategies ($p = 0.20$) or class collaboration improvements ($p = 0.41$). These results highlight disparities in learners' perceptions and the need for enhanced instructional support in some schools following professional development. The study's findings offer insights for Mathematics educators and policymakers to enhance the integration of active learning strategies in Mathematics instruction for effective implementation of CBC in Mathematics.

Keywords: Active learning, Professional Development, Mathematics Competencies, Descriptive
Survey Design.

Leveraging Technology in Mathematics Teacher Education: Reforming Training for the 21st Century in Tanzania

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Abstract

The rapid advancement of Artificial Intelligence (AI) and emerging technologies is reshaping educational landscapes, presenting both opportunities and challenges in mathematics teacher education. This conceptual paper explores the possibility of leveraging technologies and AI in mathematics teacher training curriculum in Tanzania as a reform effort. This integration will address identified gaps in the curriculum design, pedagogical strategies, and assessment methods. The paper builds on previous research that examined the current mathematics teacher education curriculum that showed that not only is the curriculum dated--developed in 2009, with an overemphasis on factual and procedural knowledge acquisition and limited exposure to technology and other AI-driven instructional tools, and a lacking infrastructure. Also missing in the curriculum are intrapersonal and interpersonal competence skills that are necessary for success in the Fourth Industrial Revolution (4IR) and beyond are critical for adaptation in a world characterized by rapid change. Grounded in Constructivist Learning Theory, Technological Pedagogical Content Knowledge (TPACK), and Diffusion of Innovation Theory, this paper advocates for integration in the mathematics education curriculum technology and AI-enhanced pedagogy, competency- based learning models, and digital literacy development. The paper concludes by proposing a structured implementation strategy, including AI-driven lesson planning, adaptive assessments, interactive simulations, and institutional capacity-building initiatives. In addition, recommendations and challenges of integrating AI and technology in the curriculum are discussed. Future research should focus on longitudinal studies assessing the integrity of the implementation of the curriculum reforms and the impact on teachers as well as on their students' mathematics learning. By leveraging technology and AI as enhancement tools rather than a replacement for educators, it is possible for mathematics teacher training to be transformed to meet the demands of the Fourth Industrial Revolution (4IR) and beyond.

Keywords: Artificial Intelligence (AI), Technology-EnhancedLearning, AI Pedagogy, Digital Literacy, Adaptive Learning, Constructivist Learning, Competency-Based Education, Fourth

Industrial Revolution (4IR), AI Ethics, Tanzania, Diffusion of Innovation, AI in Teacher Training.

Effects of a multimodal approach on the development of number sense in Grade 8 learners in Ncamagoro Circuit, Kavango West Region

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Abstract

Persistent poor performance in mathematics among Namibian learners has been attributed to the use of poor pedagogical approaches that fail to support number sense development (Chirimbana, et al., 2022). This paper reports on a study (Moses, 2025) that investigated the effects of a multimodal instructional approach on Namibia's Grade 8 learners' development of number sense. The study was guided by two research questions: "1. What are the effects of a multimodal approach on the development of number sense in Grade 8 learners? 2. How does the multimodal approach affect Grade 8 learners' retention of numerical concepts?. While previous studies in Namibia have examined number sense in the early phases of schooling (Potgieter, 2015), senior grades (Naukushu, 2011) and among pre-service teachers (Naukushu, 2016), limited research has focused on junior secondary learners, particularly Grade 8, using experimental designs. The purpose of this study was to determine whether a multimodal instructional approach, incorporating visual, auditory, and kinaesthetic modes, could offer a more effective alternative to traditional methods. A quasi-experimental design was used, involving a total population sample of 60 learners from two schools, with one group receiving multimodal instruction and the other taught using traditional teaching approaches. To determine the learner's entry level of number sense ability before the intervention, a pre-test was given to both groups. A post-test that contained identical but re-shuffled content as the pre-test was then administered to both groups again to measure the effects of the instructional approach after intervention. Quantitative data collected through pre-tests, post-tests, and follow-up assessments were analysed using t-tests and one-way repeated measures ANOVA. The results show that the experimental group performed better than the control group at every assessment point ($M = 17.93$, $SD = 2.79$ vs. $M = 15.00$, $SD = 4.63$ and $M = 16.87$, $SD = 3.39$ vs. $M = 14.1$, $SD = 4.26$, respectively), suggesting that the multimodal approach greatly enhanced both number sense development and long-term concept retention. This indicates that the multimodal approach effectively strengthened learners' understanding and retention of number concepts. The findings suggest that multimodal teaching has significant ability to improve mathematics learning outcomes in

under-resourced, rural educational settings such as that of the two schools in the Ncamagoro circuit, Kavango West Region.

Keywords: multi-modal instruction,auditory, visual, kinaesthetic and number sense.

Mathematical Programming Education: Enhancing Teaching and Assessment with PRIMM in Rwandan Teacher Training Colleges

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Abstract

The Rwanda National Competence-Based Curriculum for upper primary (Grades 4-6) promotes practical programming skills to engage students in activities like constructing geometric shapes using Turtle Art and creating interactive projects in Scratch. These activities enhance students' understanding of geometry, animation, and problem-solving skills while fostering creativity and computational thinking. Additionally, Etoys introduces an alternative programming environment, enriching students' coding knowledge. These programming experiences build a foundation in computational skills, fostering critical thinking and the application of mathematical concepts (Rwanda Education Board, 2015). However, Teacher Training Colleges (TTCs) in Rwanda do not adequately prepare preservice teachers to teach programming. While TTCs focus on pedagogy and content knowledge, programming and computational thinking are often neglected. Consequently, many preservice teachers graduate without essential programming skills or the ability to integrate technology-based learning into the classroom. This gap limits teachers' ability to implement the technology-driven curriculum that is crucial for students' digital literacy, hindering the competency-based education system's effectiveness. Kaufmann and Stenseth (2020) emphasize that programming can enhance students' understanding of mathematics and improve problem-solving skills. Across nations, including Rwanda, the teaching of programming is evolving, with ongoing research into effective pedagogical methods (Abesadze & Nozadze, 2020; Silva et al., 2015; Crick, 2017). Project-based learning has been shown to develop 21st-century skills (Abesadze & Nozadze, 2020), while the PRIMM (Predict-Run-Investigate-Modify-Make) approach (Primm Portal, n.d.), highlighted by Sentance and Waite (2017), is a sociocultural method that places students at the center of coding. PRIMM engages students in understanding, running, investigating, modifying, and making their own programs. This approach can be applied to both block-based programming (e.g., Scratch) and text-based programming (e.g., Python) and serves as a guide for tutors in planning programming lessons and activities. This paper focuses on engaging tutors at all the 16 Teacher Training Colleges

in Rwanda to teach programming using the PRIMM and project-based approaches. It also explores how tutors address the challenges AI presents in assessing programming activities. AI tools can generate code for various tasks, creating potential issues in evaluating students' work. Preliminary findings suggest that tutors are exploring ways to integrate PRIMM into their teaching and reflect on the impact of AI on the assessment of students' programming tasks. This intervention aims to bridge the gap in programming education and prepare tutors to effectively teach programming and assess students in a digital world.

Undergraduate mathematics students' understanding of the limit of a function concept: A case of students at a university in Zimbabwe.

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Abstract

This paper reports on an APOS-ACE analysis of fifty-one undergraduate mathematics students' understanding of the limit of a function concept. The researchers obtained the data from the students' written and oral responses to test items administered after a learning period of three 2-hour lectures. The results of the study revealed that more than half of the students had not developed the mental structures required to operate at object level. The researchers recommend peer discussions, use of illustrations and use of varying activities to enhance the development of the students' mental structures.

Keywords: APOS-ACE, function, limit, mathematics student, mental structure.

Use of GeoGebra in Teaching and Learning Quadratic Curves and Its Challenges: A Systematic Literature Review

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Abstract

This study explores the use of GeoGebra in teaching and learning quadratic functions among preservice mathematics teachers at the college level of education in Ghana. Despite being the simplest form of non-linear polynomial functions, these teachers often struggle with understanding more complex ones. The research explores the benefits and challenges of integrating GeoGebra into mathematical education. The study, which followed PRISMA 2020 standards for systematic literature reviews and meta-analyses, analyzed 30 research articles from over 100 published between 2010 and 2025, focusing on empirical data on the benefits and challenges of using GeoGebra in teaching quadratic functions. The study used Google Scholar, ERIC, and Dimensions as the academic databases. The selected articles were validated using content analyses and thematic analysis. The findings indicate that GeoGebra enhances students' understanding of quadratic functions, promoting active learning and engagement. It encourages curiosity and self-directed learning, transforming students from passive users to active learners. Teachers using GeoGebra often adopt inquiry- based models. However, challenges include inadequate teacher training, technical and infrastructure barriers, curriculum and assessment procedures, digital literacy issues, and classroom management difficulties. The software's effectiveness is influenced by learners with limited experience in technology-based learning environments. The review concludes that GeoGebra can improve preservice mathematics teachers' conceptual understanding of quadratic functions but recommends further research on overcoming implementation difficulties among participants.

Keywords: GeoGebra in mathematics education, teaching quadratic functions with GeoGebra, preservice mathematics teachers, challenges of using GeoGebra, GeoGebra.

EXPLORING REPRESENTATIONS OF MULTIPLICATION: A STUDY IN MOZAMBICAN GRADE 3 CLASSROOMS

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Abstract

This presentation focuses on representations of multiplication, primary teachers use for multiplication. We begin by outlining contextual aspects and challenges specific to the Mozambican educational context, particularly those affecting numeracy teaching in primary. From the learners' perspective, these refer not only to basic facts of numeracy, but also to difficulties which arise from interference from the Portuguese language (spoken in Mozambican schools) and the children's mother tongue (spoken at home, in our case Emakhuwa). With a particular focus on representations of multiplication, we provide a brief literature review and present examples of models and strategies that encompass a broad spectrum of representations related to the concept. The main aim of our exploratory study was to examine how Mozambican grade 3 teachers use representations when teaching multiplication. Specifically, we analyzed the diversity of representations employed in classroom instruction. We present findings from two case studies of Mozambican grade 3 teachers. Entire lessons were analyzed, following a qualitative research design. Results suggest that the teaching was predominantly expository, characterized by choral repetition and content reproduction. Nevertheless, instruction included concrete examples and a range of representations. However, opportunities for active student participation were limited, and the absence of manipulative materials hindered students to explore multiplication independently and meaningfully. These findings inform a discussion on enriching teaching strategies, framed within the Mozambican context.

Keywords: Multiplication, Representations, Primary mathematics education, Mozambican teachers

Mathematics teachers' perceptions of teaching and assessing students in large classes in secondary schools in Tanzania

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Abstract

This study examined secondary school mathematics teachers' perceptions of teaching large classes in Tanzania. A concurrent triangulation mixed-methods design was employed, with data collected through questionnaires, interviews, and focus group discussions. The study used purposive sampling to select 119 mathematics teachers. Quantitative data from the questionnaires were analysed using descriptive and inferential statistics, while qualitative data were analysed thematically. The findings indicated that mathematics teachers held positive perceptions of employing a variety of strategies to teach large classes. However, assessing students' learning in large classes was perceived as highly challenging. The study found statistically significant differences in teachers' perceptions of teaching methods based on their level of education. Similarly, significant differences were identified in teachers' perceptions of assessment practices in large classes by their teaching experience. However, no statistically significant differences were observed in teachers' perceptions of teaching methods and assessment practices based on training. This paper concluded that training alone is insufficient to change teachers' perceptions of teaching large classes. We recommended that training providers consider factors such as teachers' level of education and teaching experience when designing and delivering training programs.

Keywords: Teacher training, teacher perception, large classes, mathematics, secondary school level

Imitative and creative reasoning in Euclidian geometric proof tasks within South African Grade 11 mathematics textbooks.

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Abstract

This research study explored opportunities for imitative and creative mathematical reasoning in Euclidean geometry tasks in three Grade 11 mathematics textbooks. Using a textbook content analysis method and qualitative research approach, the study applied Zhang and Qi's analytical framework for reasoning and proof (R&P) to evaluate 753 tasks. Of these, 510 tasks that included R&P were examined in detail using Lithner's conception of imitative and creative reasoning. The findings revealed that the textbooks effectively provided tasks aimed at enhancing reasoning skills, primarily through formal proofs. However, informal reasoning processes—such as conjecturing and evaluating arguments—were often overlooked. Most tasks required imitative reasoning with minor modifications, while those fostering creative reasoning were underrepresented (4.44%), with one textbook excluding this entirely. The study suggests a framework to better integrate R&P tasks that promote imitative and creative reasoning.

Keywords: Reasoning-and-Proof, creative mathematical reasoning, imitative mathematical reasoning, mathematics textbooks, levels of relatedness.

THE USE OF CODE-SWITCHING IN TEACHING AND LEARNING MATHEMATICS IN MULTILINGUAL PRIMARY SCHOOLS IN SOUTH AFRICA

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Abstract

The purpose of this study was to provide a systematic review of research that has been carried out between 2018 and 2024 on the use of code-switching in teaching and learning mathematics in multilingual primary schools in South Africa. To select literature to include in this study, three criteria for inclusion were identified: research studies needed to focus on the use of code-switching in the teaching and learning of mathematics in multilingual primary schools (grade R – 7), research studies needed to relate specifically to the use of code-switching in the South African context of teaching and learning mathematics and research studies needed to have been published in English between 2018 and 2024. Research studies that focused on code-switching in other learning subjects, code-switching in secondary and tertiary mathematics education, published before 2018, published in other languages and not specifically focused on South African primary schools were excluded. The findings of the reviewed research studies indicated that code-switching is a useful pedagogical practice used by teachers to help learners with low English proficiency comprehend mathematical content. Despite the evidence that code-switching helps learners with low English proficiency understand mathematical concepts, the review of the selected literature also highlighted several key challenges of using code-switching in the teaching and learning of mathematics in multilingual primary schools. These key findings include its potential to hinder learners' development of proficiency in the language of instruction and whether teachers should work on developing learners' proficiency in English or develop mathematical meaning in learners' home language. The study recommends the development and implementation of teacher professional development programs that will equip teachers with new effective skills that will improve their use of code-switching in the teaching and learning of mathematics in multilingual primary schools. Furthermore, it recommends that the DBE and the language in education policymakers formalise the use of code-switching in teaching and learning mathematics by amending the existing language in education policy.

The Fast-Thinkers Game as a Grade 12 Accounting and Mathematics Interdisciplinary Teaching and Learning Tool.

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Abstract

Tertiary institutions that offer accountancy programmes require specific skills, such as communication, reading, and time management skills, from Grade 12 learners to ensure they are well-prepared for their training as future accountants. The lack of or absence of these mentioned skills at the school level has a snowball effect on the higher education sector. The primary purpose of this paper is to develop a board game for accounting and mathematics learners that can be used as a learning intervention to improve their subject knowledge and skills. The concept of the popular board games 30 Seconds and Monopoly was used to develop the Fast-Thinkers Game for Grade 12. Purposive sampling was used to obtain feedback from 176 Grade 12 learners from the Free State Province who attended the '2024 Finance and Accounting Services Sector Education and Training Authority (FASSET) & South African Institute of Chartered Accountants (SAICA) Development Camp'. The camp offered academically talented Grade 12 learners from Quintile 1 to 3 schools additional academic support in Mathematics, Physical Science and Accounting. The study utilised a quantitative research approach and was structured around the Design-Science Research method framework. The perceptions of the learners in relation to the learning intervention were determined by means of a questionnaire containing both open-ended and closed-ended questions. The questionnaire was designed and conducted by Evasys, while the software SPSS was used to analyse the collected data. The findings indicated that the learners not only enjoyed playing the game but also improved their skills, such as verbal communication, reading, short-term memory, teamwork, engagement and time management. Apart from the skills obtained, the learners also gained a better understanding of mathematics and accounting terminology and content. The positive outcome of this paper indicates that the Fast Thinkers Game for Grade 12 learners as a learning intervention can be used by educators and curriculum developers.

Keywords: Accounting education; Design-Science Research; Game-based learning; Mathematics education.

Secondary mathematics teachers' shared identity: Insights from a quantitative analysis of participation in a professional development course

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Abstract

Teacher identity in mathematics education has largely been researched using qualitative approaches. However, in this article, we discuss the use of a quantitative approach for exploring the contribution of teachers' shared experiences of a professional development course to shifts in their professional identities. We developed a closed-ended questionnaire to collect data from 45 participating teachers. The questionnaire data was subjected to Exploratory Factor Analysis. From the analysis, teachers' shared identity shifts emerged as being connected to their understanding of mathematics and their confidence in learning and teaching the subject.

Keywords: Teachers' shared experiences, teachers' shared identity, community of practice, closed-ended questionnaire, Exploratory Factor Analysis, quantitative study

Teaching and Learning of Mathematics by Visually Impaired Learners; A Case Study of Inclusivity in Mathematics Education at Sefula School for the Visually Impaired, Western Province, Zambia.

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Abstract

This study investigated the teaching and learning of Mathematics by visually impaired learners; a case study of inclusivity in Mathematics Education, carried out at Sefula School for the visually impaired, in Western Province, Zambia. The sample had a total of 43 learners with visual impairment, and then 3 teachers, 1 of whom is visually impaired. The study utilized an interpretative research paradigm. The instrument mainly employed were both open and closed interviews, which included a questionnaire that was orally administered. The following challenges were highlighted; lack of computer assisted learning tools, few trained resource teachers, negative stigmatization by school community and surrounding populace, and also little government support in terms of budgetary allocation. The results further revealed that more research efforts meant to improve mathematics education for the visually impaired needs to be done. In order to improve the status call and effectively reduce on most of these challenges, the respondents suggested the following; more teachers be trained in mathematics for the visually impaired, gadgets fitted with lessons for the visually impaired must be procured, an inclusive infrastructure needs to be promoted, and more sensitization aimed at reducing discrimination for the visually impaired should be carried out regularly.

EXPLORING THE MATHEMATICS TEACHERS' BELIEFS, ATTITUDE AND BEHAVIOR (BAB) IN ICT MEDIATED LESSONS: A CASE STUDY OF FOUR MATHEMATICS TEACHERS.

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Abstract

This study explored the primary teacher's beliefs, attitudes and behavioural (BAB) intentions to use Information and Communication Technology (ICT) and how teachers' beliefs were enacted in the actual teaching of the concept of time. This was a qualitative case study on four primary school teachers from an international independent school in Johannesburg, South Africa when they were teaching the topic of time. The study was guided by the unified theory of acceptance and use of technology (UTAUT) model. Data were analysed thematically but some descriptive statistics were used to illuminate the qualitative analysis. The major findings of the study indicated some positive teacher perceptions in the facile use of ICT and the pedagogical potential of ICT to improve teaching and learning mathematics. All participants felt the urge and showed motivation to integrate ICT in mathematics teaching and learning. However, the study showed that in general, they lack onsite technical support, encouragement from the school leadership, unreliable ICT infrastructure, and the lack of training and professional development in the pedagogical use of ICT. The study recommends that the school leadership should encourage teachers and be very explicit about the benefits of integrating ICT into mathematics teaching. It should provide onsite technical support, adequate ICT infrastructure as well as continued training and professional development to boost teachers' competencies in the pedagogical use of ICT in mathematics teaching and learning.

Keywords: Beliefs Attitude and Behaviour, Grades 3, 4 and 5 Teachers, Information and Communication Technology Teaching and Learning Time. Unified Theory of Acceptance and Use of Technology, Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Behavioural Intentions

Exploring the Pedagogical Content Knowledge of Standard 2 Mathematics teachers in Malawi.

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Abstract

This study analysed teachers' knowledge of the curriculum, content and pedagogy for teaching shapes in Standard 2 in Malawi, using the Pedagogical Content Knowledge (PCK) framework. PCK can be described as the blending of content and pedagogy into an understanding of how topics, problems or issues are organized, represented and adapted to meet the diverse needs of learners and presented for instruction. Mathematical content knowledge and pedagogical knowledge are integrated parts of effective mathematics instruction. The purpose of this study was to find out Standard 2 teachers' content knowledge of shapes and how they integrate their content knowledge with pedagogical knowledge for instruction. Qualitative data was collected from ten Standard 2 teachers from ten schools in Malawi in term one of the 2024/25 academic year. The schools were purposively sampled to include teachers who were teaching shapes during the time of data collection. Data was collected through lesson observations and in-depth interviews with sampled teachers. Findings of the study showed that teachers had knowledge of content, pedagogy and curriculum of two-dimensional shapes' (circle, square, rectangle and triangle). They showed conceptual understanding of two-dimensional shapes and this influenced classroom instruction in a positive way. However, teachers showed limited knowledge of three-dimensional shapes (cubes, cuboids, cylinders, spheres, prisms). The limitations were observed in their choice of representations, teacher talk, engagement with learners and support given to learners to complete tasks in the workbook among others. Teachers' limited content knowledge of three-dimensional shapes affected their understanding of the curriculum and choice of pedagogy for teaching shapes.These findings agree with several research studies that have shown that Geometry is one of the mathematical domains least understood by early grade teachers. Teachers are only able to provide basic instruction on geometric shapes without aiming at developing learners' spatial thinking. In this study, it was observed that in 80% of the Standard 2 classes, the learning of three-dimensional shapes was theoretical. The implication that these findings have is that learning geometry in upper classes may be difficult for learners.

Keywords: Geometry, pedagogical content knowledge, early grade teaching, (two- and three-dimensional) geometric shapes

The Impact of Combined Teaching Strategies on Students Performance in Large Mathematics Classes

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Abstract

Large classes have become a global concern that attracts policy and research attention worldwide. Schools in both developed and developing countries are adversely affected by the presence of large number of students in a class. There is a need for an evidence-based pedagogical approach that can improve students' learning outcomes in large mathematics classes. Therefore, this current study was conducted to examine the effect of combining lecture, think-pair-share, and whole-class discussion methods in enhancing students' academic achievement in large mathematics classes. The study employed a quasi-experimental design involving 356 students from four secondary schools. The students were divided into experimental and control groups, with the experimental group receiving instruction through a combination of lecture, think-pair-share, and whole-class discussion, while the control group was taught using lecture methods. Pre-tests and post-tests were administered to assess students' performance before and after the intervention. Statistical analysis was conducted using paired samples t-tests, independent samples t-tests, and ANCOVA to measure changes within groups, differences between groups, and the impact of initial pre-test scores. The preliminary findings indicate a statistically significant improvement in post-test scores for both groups, with the experimental group revealing a greater mean increase. Also the findings reveal that combining lecture; think-pair-share, and whole-class discussion enhances students' engagement and participation in large classes. Based on these findings, we argue that a combination of lecture; think-pair-share, and whole-class discussion strategies is effective in teaching and learning in large classes. Thus, we recommend teachers use this combination for effective teaching and learning in large classes' situation.

Keywords: Large classes, teaching and learning, mathematics, combining teaching strategies

PERFORMANCE DISPARITIES BETWEEN CALCULUS OF MOTION AND NON-MOTION QUESTIONS IN THE NATIONAL SENIOR CERTIFICATE EXAMINATIONS, SOUTH AFRICA

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Abstract

The premise of this study is that there is a performance disparity between learners studying Mathematics together with Physical Science (MPS) and learners studying Mathematics only without Physical Science (MWPS). Understanding these performance disparities is crucial for teachers seeking to facilitate learning and assess these learners who sit together in one classroom. To understand the disparities, National Senior Certificate (NSC) Grade 12 final examination marks obtained from the Department of Basic Education (DBE) that relate to the topic of calculus of motion were analysed. The overall achievement marks between the calculus of motion questions and the alternative questions to the calculus of motion were scrutinised. Data was collected through the NSC diagnostic reports written by DBE and past NSC examination question papers. The findings of this study showed that there is a difference in performance between MPS and MWPS learners. Hence, knowledge of Physical Science might have played a role in successfully answering questions based on calculus of motion. The purpose of this study is to provide teaching and assessment strategies aimed at minimising performance disparities amongst Mathematics learners who study Mathematics without Physical Science.

Keywords: Performance disparities, Calculus of motion, Examination marks, Achievement marks, Diagnostic reports

HARNESSING THE EPISTEMIC POTENTIAL OF MULTIPLE LANGUAGES IN TRANSITIONAL MULTILINGUAL MATHEMATICS CLASSROOMS IN SOUTH AFRICA

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Abstract

The transitional model is the most common approach for including indigenous languages in formal education in most African countries and involves using an indigenous language for instruction over a certain number of years for formal education before transitioning to a 'global' language (Trudell, 2023). In South Africa, this transition takes place in Grade 4 (on average, age 10). However, this shift raises questions as to whether students have gained access to both communicative and academic proficiency in the home language and English and can, therefore, be taught mathematics in English from Grade 4 onwards (Essien &; Sapire, 2022). This paper proposes a framework for rethinking teaching in transitional classrooms in a way that draws on and exploits the epistemic potential of the multiplicity of languages in classrooms to benefit students who have experienced language transition. Drawing on data from a research and development project that combines teacher professional development and classroom observations of language transition classrooms, we bring together both the translanguaging framework and the language responsive mathematics teaching framework. The resulting merger framework reifies and recontextualises the 'jobs' of teachers in transitional multilingual mathematics classrooms in such a way that accounts for 12 horizontal, vertical and diagonalised bi-directional movements between languages and their different forms for epistemic access. Preliminary findings from the use of this merger framework for teacher development indicate that it is a useful tool for showing how teachers (can) draw on and exploit the epistemic potential of multiple languages in multilingual mathematics classrooms to benefit students. This is particularly important as South Africa moves towards building a strong and efficient mother-tongue based bi/multilingual education.

(Not) Just a "Math Person": A Study of How Mindset and Motivation Shape Students' Decisions to Pursue Mathematics Education

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Abstract

Mathematics education is not only central to national development but also vital to equipping students with critical problem-solving skills. However, teacher education programs in mathematics face growing challenges in attracting and retaining undergraduate students. A recurring influence on students' career decisions is the stereotype of the "math person"—an individual assumed to possess innate, exceptional mathematical talent. This fixed notion of ability can discourage capable students from pursuing mathematics education, especially if they do not immediately identify as naturally gifted in the subject. This study investigates how students' internal beliefs—specifically their mathematical mindset and motivation—shape their decision to pursue and persist in mathematics education. Drawing on mindset theory (Dweck, 2006), self-determination theory (Deci &; Ryan, 1985), and literature on mathematics identity (Boaler, 2013), the research examines the interplay between students' perceptions of their ability, their motivation types (intrinsic vs. extrinsic), and their emerging identities as future educators. A mixed-methods design was employed to gather both statistical and narrative data. Quantitative data were collected from 150 pre-service mathematics educators enrolled in two Rwandan institutions—University of Rwanda College of Education and East African University Rwanda—via structured questionnaires. These instruments assessed correlations between mindset orientation (fixed vs. growth), types of motivation, and intentions to remain in mathematics education. The qualitative phase involved semi-structured interviews with a purposive sample of 20 students, offering deeper insight into how students' identity formation and emotional engagement with mathematics evolved throughout their academic journeys. Preliminary findings suggest that students with a growth mindset—who believe that mathematical ability can be developed through effort and support—are more likely to report strong academic confidence and intention to remain in teacher education programs. In contrast, those with a fixed mindset often express persistent self-doubt and are more likely to consider leaving the program, even when their performance is objectively adequate. Motivational orientation was also found to be a key predictor of persistence. Students driven by intrinsic motivation—such as a genuine love for mathematics

or a desire to help others learn—demonstrated higher resilience and engagement. Conversely, students whose decisions were shaped by extrinsic motives (e.g., job security or social expectations) often expressed ambivalence about their future in teaching, especially when facing academic challenges. Importantly, many interviewees described their transformation from non–math person to confident educator as gradual and enabled by supportive academic environments, mentorship, and classroom success. This underscores the significance of affirming institutional cultures that challenge fixed-ability narratives and promote growth-oriented teaching practices. This study highlights the need to move beyond academic preparedness and address the affective and identity-based dimensions of becoming a math educator.

THE IMPACT OF THE FOUNDATION PHASE MATHEMATICS CURRICULUM ON DEVELOPMENTAL DYSCALCULIA IN SOUTH AFRICA.

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Abstract

This study provides an in-depth examination of how the mathematics curriculum impacts the development of dyscalculia among learners in the Foundation Phase. Adopting a qualitative research approach, the study interviewed foundation phase teachers from mainstream and special schools in-depth. Additionally, it incorporated direct observations of their mathematical teaching practices in real classroom settings. The findings reveal that the mathematics curriculum hinders learners' acquiring essential mathematical knowledge and skills. A significant concern highlighted by the study is that teachers often feel pressured to skip or expedite the teaching of fundamental concepts to meet the expected outcomes of the curriculum. This pressure arises from accountability measures and a focus on standardized assessments, which can lead to a detrimental teaching pace. Moreover, the research uncovered that even when teachers identify students who have not fully mastered previous mathematical concepts, they feel compelled to advance to new topics. This occurs alongside the introduction of various problem-solving strategies, which can overwhelm learners who lack a solid understanding of the foundational concepts. As a result, this rushed progression adversely affects learners' current academic performance and undermines their future mathematical learning capabilities. Without a strong foundational understanding, these learners may struggle to engage with more complex mathematical concepts later, creating a cycle of difficulty that can persist throughout their educational journey. The study calls for evaluating curriculum pacing and teaching methodologies to ensure all learners develop the necessary groundwork for successful mathematical development.

Early Algebra: Snapshot of Foundation Phase Teachers learning to focus on structure

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Abstract

This paper shares the experience of six Grade 2 teachers as they explored new ways of teaching sequencing, guided by a series of carefully planned workshops within the context of the Early Algebra (EA) debate. The study used a mixed model design, combining document analysis, classroom observations, and hands-on professional development. A key part of the intervention was a calendar- based activity that helped teachers uncover and work with different types of structure—surface, systemic, and oblique. Through this process, the teachers gradually moved beyond basic number operations, developing a deeper understanding of numerical relationships and how these can be used to support generalisation. Introducing the idea of a "pivotal point," represented by an indeterminate like n or p, helped shift their focus from working with specific numbers to reasoning structurally. The calendar proved to be a powerful, accessible classroom tool for building early algebraic thinking. By the end of the process, teachers showed clear growth in both their subject knowledge and teaching approaches, particularly in how they used structure to help them generalise the relational features. This study highlights how well-designed professional learning opportunities can make a meaningful difference in helping teachers developing algebraic reasoning as a pedagogical content tool.

Considerations For University Mathematics Teachers Through Exploring Students' Prior Knowledge

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Abstract

This paper reports on strengths and weaknesses in students' prior mathematical knowledge at the start of their university calculus course, and in preparation for a mathematical modelling unit developed in the project Comparative Studies into Teaching Approaches for Mathematical Modelling (CoSTAMM). An investigation based on four samples (altogether 2007 participants) of university science and engineering students (2019 – 2022) has yielded interesting results with the aim to determine: (i) the students' performance level at the start of the course, and (ii) knowledge gaps that highlight the necessity for additional support for students' future mathematical work in general and for the mathematical modelling unit in particular. Quantitative data were collected from a diagnostic test and Welch's t-tests for independent samples were used to compare the results. Overall, students were rather weak and significant differences between groups and content areas were found. A further qualitative evaluation of students' mathematical work was conducted on a randomly selected sample of 80 students for deeper insights, particularly related to errors and misconceptions which occurred in all test sections. From a constructivist perspective errors and misconceptions should be addressed in future mathematical work. Results from this study show university mathematics teachers should consider students' prior knowledge when planning teaching and learning opportunities.

Keywords: CoSTAMM, Mathematical errors, Mathematics students, Misconceptions, Prior knowledge, Tertiary level, University teachers.

Errors in Trigonometric Proof-related-reasoning Tasks: Insights from Grade 10 learners in an Eastern Cape School

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Abstract

This qualitative case study explores Grade 10 learners' errors in trigonometric proof-related reasoning tasks at a rural Eastern Cape school. The research questions are: What errors do learners make when solving trigonometric proof-related reasoning tasks? How do learners perceive and interpret the errors they made while solving these tasks? The study used Newman's error analysis framework and qualitative case study research methods to address these research questions. Written responses from 30 learners revealed process-skill errors as dominant (50%), marked by incorrect formula application and procedural inaccuracies, followed by comprehension errors (30%) due to misinterpreting angle constraints, transformation errors (14%) from inappropriate model selection, and encoding errors (6%) in final answer presentation. Tasks requiring multiple representations showed higher error rates than procedural ones. Semi-structured interviews with five learners highlighted surface-level strategies, with reliance on memorised formulas and procedures without conceptual understanding. Misconceptions about quadrant-based trigonometric values and low metacognitive awareness further impeded reasoning. The study provides implications for instructional teacher practice centred on promoting reasoning and proof skills.

Keywords: Errors; misconceptions; proof-related reasoning; trigonometry.

Utilizing mathematics tasks to help pre-service teachers notice the relevance of multiple representations

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Abstract

There is a general agreement within the mathematics education community that multiple representations play an important role in teaching and learning of the subject. Studies on mathematical representations have mainly focused on how school learners interact with representations during lessons and little focus has been paid to pre-service teachers' ability to notice multiple representations and the role representations play in connecting mathematics concepts. This paper seeks to use mathematics tasks to elicit pre-service teachers' ability to notice representations. Two hundred and twelve first year pre-service teachers participated in the study and worked on a set of mathematics tasks. The tasks were of different cognitive levels, varying from those accompanied by some representations to those that had none. Analytical typology on presentational noticing was used for the analysis. This study found that pre-service teachers struggled to realize the relevance of some prearranged representations in some tasks. They also found it challenging to deal with unfamiliar word problems. Recommendations are that mathematics education modules need to put more emphasis on the use of representations and how they assist in connecting mathematics concepts so that upon completion of the course pre-service teachers would have gained confidence to flexibly use representations in teaching mathematics. A similar study ought to be done in the final years to see if they developed representational skills over their study period. Further studies on how both pre-service and in- service teachers perceive relevance of representations and how they make tasks accessible to learners are needed especially in the sub-Saharan Africa where the quality of mathematics teaching remains problematic for many.

Keywords: Pre-service teachers; multiple representations; teacher noticing; mathematics tasks.

Facilitating a Positive Shift in Students' Engagement with Mathematics: Insights From 21 Maths Camps

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Abstract

Mathematics education remains a significant challenge in many African contexts, particularly in rural areas, despite being a fundamental and highly creative discipline that underpins various careers. The need for innovative educational approaches has become more urgent following global disruptions such as the COVID-19 pandemic. To address these challenges, 21 mathematics camps were facilitated across Kenya, Tanzania, and Rwanda between April 2021 and February 2025, creating immersive and supportive learning environments that enhance mathematical reasoning, problem-solving skills, and lifelong learning. This paper explores how the diverse tasks introduced in these camps contribute to student engagement with mathematical concepts, as many of these tasks align with the highest levels of Smith and Stein's (1998) taxonomy of mathematical tasks. By analyzing students' reflective journals, the study highlights the following five themes related to shifts in attitudes toward the subject: Skills acquisition; Self-Efficacy; Impact on knowledge and understanding; Enjoyment and fun in Learning; and Mathematics for its own sake. The study also highlights the results of students' engagement with mathematical ideas during camp activities which include the acquisition of knowledge, competencies, and self-efficacy. Additionally, the paper underscores the importance of learning activities that allow for inclusivity and diversity. The study highlights the effectiveness of innovative instructional approaches, including games and puzzles, technology integration, hands-on learning, immersive environments, teacher professional development, and themes in data science, mathematical modeling, and computational thinking. Findings indicate that these strategies significantly enhance student engagement and confidence in mathematics. The paper concludes with recommendations for scaling up such initiatives to foster inclusive, high-quality mathematics education across Africa.

Integrating the Concept of 'Ayatutu' into Mathematics Education: Exploring Collective Problem-Solving and Cooperative Learning

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University of South Africa,

Abstract

Integrating cultural elements into mathematics education has been shown to enhance student engagement and understanding. For instance, African traditional games like Mancala have been utilized to teach mathematical concepts, demonstrating the effectiveness of culturally relevant pedagogy. This article explores the integration of 'Ayatutu', a communal philosophy from Nigeria's Tiv people, into mathematics education frameworks. Ayatutu—embodying collective responsibility and mutual assistance—aligns with contemporary cooperative learning approaches while offering unique cultural dimensions. Through analysis of ethnomathematics literature, indigenous knowledge systems, and cooperative learning theories, the article develops a theoretical framework for Ayatutu-based mathematics instruction built on five core elements: collective problem-solving, resource sharing, complementary expertise, process orientation, and intergenerational knowledge transfer. The framework demonstrates significant alignment with sociocultural learning theory, communities of practice, and critical pedagogy while offering potential benefits including enhanced mathematical engagement, positive identity development, stronger learning communities, and cultural sustainability. Implementation challenges involving teacher preparation, structural constraints, cultural translation, and balancing individual with collective learning are examined. The research contributes to decolonizing mathematics education by positioning indigenous philosophical systems as valuable resources for creating culturally responsive and mathematically powerful learning environments that serve diverse student populations while honoring cultural wisdom. The paper recommends, among others, that Education policymakers should support exploration of indigenous philosophies in mathematics education through curriculum flexibility policies that allow for innovative approaches that may not align with conventional pacing and assessment models. Such flexibility would create space for teachers to implement the more process-oriented, collaborative approaches without feeling constrained by rigid pacing guides. In conclusion, the study posits that through respectful engagement with indigenous philosophies like Ayatutu, mathematics education can become both more culturally sustaining and more mathematically powerful, better serving diverse learners while honoring the intellectual

contributions of cultures historically marginalized in educational contexts.

Keywords: Indigenous knowledge systems; Cooperative learning; Mathematics education; Ayatutu; Cultural pedagogy; Ethnomathematics; Collective problem-solving

A Symposium on MULTIPLE PERSPECTIVES ON IMPLEMENTATION OF COMPETENCY BASED EDUCATION

Angel Mukuka, Mary Ochieng, Penina Kamina, Marguerite Khakasa Miheso & Herine Otieno

Several countries in Africa have implemented Competency Based Education (CBE). However,
CBE implementation has not been without challenges hence the need for some deliberation on
this in a forum like AFRICME 7. In this symposium we will present multiple perspectives on implementation of Competency Based Education in mathematics classrooms. The five presentations will be as follows:

1. A description of CBE implementation in Zambia titled "Zambia's Perspective on Competence-Based Curriculum Implementation in Mathematics Education"
2. Comparison of Kenya and the US titled "The Mile Wide and an Inch Deep Comprehension of Mathematics"
3. A teacher educator's role perspective of implementation titled, "Repositioning Mathematics Education in Kenya: The Role of Teacher Educators in Competency-Based Curriculum Implementation"
4. A perspective from the gender gap, titled "Promises and pitfalls of Competency Based Curriculum reforms in Africa in addressing the gender gap in learning outcomes in mathematics."
5. Positioning of Mathematics in the Competency Based Curriculum titled, "What is mathematics? Reflecting on the CBC instigated recent debates and public 'uproar' on making mathematics an optional subject for some CBC pathways at Senior secondary level education in Kenya."

The five perspectives though not exhaustive still provide a comprehensive view of CBE that can
allow for fruitful deliberations among participants.

ANALYSIS OF EARLY GRADE TEACHERS' ORCHESTRATION OF ARTEFACTS IN THE TEACHING OF WHOLE-NUMBER ADDITION IN MALAWI

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Abstract

In an early grade classroom, physical and material objects—called artefacts—serve an important role in mediating learners' encounters with mathematical concepts. This paper discusses how some four early grade teachers in Malawi worked with artefacts in the teaching of whole-number addition in the first four grades of primary school. It reports a part of the findings from a larger study that utilized the Mediating Primary Mathematics (MPM) framework to analyse how teachers work with various means of mediation in the classroom. Using a qualitative case study design, data were collected through lesson observations, interviews, and document analysis. Among other things, the findings revealed that teachers use both structured and unstructured artefacts to enhance learner engagement and model mathematical concepts. The study highlights the importance of flexible movement between physical and abstract representations of concepts to promote mathematical cognition and suggests improvements in the use of artefacts to enhance deeper understanding of mathematical connections.

Keywords: Artefact, mediation, early grade, mathematics, Malawi

OPERATIONALISING SITUATIONS OF TEACHER NOTICING OF LEARNER MATHEMATICAL THINKING IN SOUTH AFRICAN CONTEXT

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Abstract

Although there is a growing consensus within the mathematics education community that noticing is crucial for effective teaching as stipulated in reform documents. Noticing allows teachers to selectively pay attention to noteworthy aspects of a complex instructional setting. Professional noticing is an important mathematics instructional practice which supports responsive teaching as it allows the teacher to build on learners mathematical thinking as evidenced in their contribution Studies reveal that both responsive teaching and noticing are extremely challenging and demanding and that developing these skills is complex (Scheiner, 2023; Jessup, 2025). For example, to be effective, teachers need sound knowledge of the constituents of mathematical significance and be able to discern their manifestation in learners' strategy, that are often haphazard and uncoordinated. Jacobs et al.'s (2010) framework recognises three levels of noticing competency: no evidence; limited; and robust. Professional development of teachers' professional noticing often does not go beyond limited noticing after an extended duration. Similarly, Abdulhamid and Venkat (2018) find the complexity of developing responsive teaching among primary mathematics teachers in South Africa and proposes three situations in which teachers often required to respond to unexpected learner offers: incorrect offers; correct offers that were viewed as inefficient; and correct learner offers, that needed to be projected to the entire classroom with some sort of teacher elaboration. We draw on Abdulhamid and Venkat's (2018) three situations of contingency and then propose three situations of noticing: incorrect learners' mathematical thinking; correct but inefficient learners' mathematical thinking; and correct learners' mathematical thinking. The intention for the incorrect mathematical thinking is obvious, as the teacher is expected to attend, interpret the incorrect offer/thinking, and decide to respond. The situation of correct offer is a pedagogical move that a significant aspect of correct mathematical thinking needs to be projected with some teacher elaboration to the entire classroom space. In this presentation, we draw on data from our study of Grade 8 mathematics teachers' professional noticing of learners' thinking about common fractions, using examples to illustrate each of these three noticing situations. We argue that this

operationalisation is valuable for supporting the development of teachers' professional noticing of significant aspects of learners' mathematical thinking.

The impact of structured mentoring program on the self-efficacy of the Newly Qualified Mathematics Teachers in selected secondary schools of Kabwe District in Central Province of Zambia

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Abstract

This study investigated the impact of a structured mentoring program on the self-efficacy of newly qualified mathematics teachers (NQMTs) in selected secondary schools in Kabwe District, Zambia. Guided by Bandura's Social Cognitive Theory and using a pragmatic, embedded mixed-methods design, the research combined quantitative pre- and post-test assessments with qualitative interviews and open-ended questionnaires. A sample of 66 NQMTs was divided equally into mentored and non-mentored groups, with structured mentorship implemented over 12 weeks. The findings revealed that mentored teachers experienced a significant increase (42.05%) in self-efficacy across twelve Key Result Areas (KRAs), particularly in instructional strategies, classroom management, and student engagement, compared to just 4.15% in the non-mentored group. Qualitative data supported these results, emphasizing the importance of observational learning, collaborative lesson planning, constructive feedback, and emotional support. The study concludes that structured mentoring programs effectively bridge the gap between theoretical training and classroom practice, enhancing both technical competence and professional confidence. It recommends institutionalizing mentoring as a core component of teacher induction and professional development in Zambia's education system.

Keywords: Self-efficacy, structured mentoring, newly qualified teachers, mathematics education, teacher development, Social Cognitive Theory, Zambia

Primary school teachers' experiences of teaching mathematics using Smartboard technology

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Abstract

Within this age of technology, scholars, policy makers and even Department of Education (DoE) has advocated for its incorporation in daily teaching and learning. With this idea, the South African DoE in Gauteng has installed several Smartboards for teachers to use when teaching in different schools around the province. However, after training several teachers within the province, there is still a lack of empirical evidence, not only on how teachers are experiencing the transformation from chalkboard to Smartboards for teaching but also on how the integration of Smartboards influences teaching and learning. To address this under-research area, this study investigated primary school teachers' experiences of teaching mathematics using Smartboards using qualitative methods. Data was collected using semi-structured interviews and classroom observations. Eight primary school teachers from the same school were purposively sampled to represent a broad range of experiences and teaching contexts. Data was analysed using a thematic analysis to identify patterns and themes related to how teachers used Smartboards for teaching mathematics. The findings revealed that Smartboards provide students with more hands-on and visual lessons. However, teachers also indicated that they were frustrated with technology troubleshooting and the longer learning curve of using Smartboards for teaching mathematics effectively. Despite their technological problems, most teachers indicated that many students were more engaged in mathematics lessons and were able to grasp mathematical ideas and concepts better when the Smartboard was used. The study provides suggestions for professional development and teacher support systems that can help teachers fully utilise Smartboard technology in the mathematics classroom, as well as recommendations for future research.

Keywords: Smartboard technology, Technology integration, Teachers' experiences, Learner engagement, Technology enhanced learning, Primary school mathematics

Implementation of Science, Technology, Engineering and Mathematics (STEM) curriculum in science teacher education in Zimbabwe.

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Abstract
The implementation of science, technology, engineering and mathematics (STEM) policy has been marred with a lot of distortions which ultimately affects the student teacher who is the final product. This chapter presents findings from a study which explored how Science teacher education implemented the STEM curriculum in Zimbabwe. The study adopted an interpretive research paradigm in which a multiple case study design of ten (10) science lecturers at colleges and universities was used. Document analysis and in-depth semi-structured interviews were used to collect data. The active learning conceptual model was used for the study. Findings were analysed using Content analysis. Results revealed mixed perceptions on STEM amongst educators from the two education ministries. Some perceive of STEM as practical work while others as no different from the natural sciences discipline subjects. Participants cited challenges militating against effective STEM education implementation as emanating from poor institution linkages with industry and schools and lack of teaching and instructional resources. The chapter concludes that despite the noble intentions of STEM implementation, poor conceptualisation of the innovation has resulted in its misinterpretation and flawed implementation in colleges and universities, and consequently in schools. It is recommended that teacher education lecturers be sensitised on the STEM philosophy and how it can be implemented.

Keywords: STEM Education curriculum; policy implementation; STEM integration, innovation;
training; teacher education

EMBRACING CHALLENGES: THE ROLE OF PRODUCTIVE STRUGGLE IN OVERCOMING CALCULUS MISCONCEPTIONS IN TVET SETTINGS

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Abstract

In this study, the productive struggle role was deliberated in addressing calculus misconceptions among TVET college students. It is essential to the successful development of many applications in engineering, yet many students emerge having high levels of misconception that affect their study and careers. Using qualitative methods such as semi-structured interviews and focus group discussions, this exploration focuses on how struggling against difficult tasks in calculus can yield understanding and grit. Research has shown that productive struggle not only helps alleviate misconceptions especially for concepts such as limits, derivatives and integrals, but is also positive for learning in groups. The results are in-line with constructivist premises, providing productive struggle and clearing misconceptions results in enhanced mathematical identities and attitudes towards learning mathematics. It highlights the need to develop spaces in classrooms that promote risk-taking.

Keywords: Productive struggle Calculus Misconceptions Peer Collaboration Mathematical understanding Problem-solving strategies

TECHNIQUES AND STRATEGIES FOR PREPARING PRE-SERVICE TEACHERS FOR DIGITALIZED MATHEMATICS CLASSROOMS: ANALYSIS OF DIGITAL TECHNOLOGY TOOLS

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Abstract

The accelerating influence of the Fourth Industrial Revolution (4IR) is transforming education, particularly in mathematics teacher preparation. This study investigates how teacher educators in South Africa integrate digital tools to prepare pre-service teachers (PSTs) for technology-driven classrooms. Particularly when digital technologies offer significant potential to enhance critical thinking, conceptual understanding, and problem-solving in mathematics, many PSTs still graduate without the skills to apply these tools effectively in practice. This is a conceptual paper framed by the Technological Pedagogical Content Knowledge (TPACK) framework conceptualized by Mishra and Koehler (2006) and the SAMR Model developed by Ruben Puentedura (2006). The study examines and evaluates techniques and strategies used to integrate and advance digital technology in teacher education and the difficulty of aligning digital tools with teacher preparation. The following research questions aim to address the study: What technological techniques and strategies do teacher educators use when preparing their pre-service teachers to teach using digital technology in mathematics education classrooms in the South African context? The research questions aim to identify best practices and strategies for integrating digital technologies into mathematics education, enhancing teaching and learning outcomes. By identifying effective practices, the study contributes to the discourse on preparing PSTs to meet the demands of 21st-century teaching in digitized learning environments and supports the development of best practices for technology integration in mathematics education. Ensuring that PSTs are equipped to meet the challenges and opportunities of a digitalized mathematics classroom.

Keywords: Digitalized Mathematics Classrooms, Techniques and Strategies, TPACK, Fourth Industrial Revolution, Digital Technologies, Pre-Service Teachers (PSTs)

Trends and Distribution of Primary School Mathematics Teachers' Content Knowledge in South Africa: A Systematic Review (2005–2025)

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Abstract

The persistent challenges in mathematics achievement among primary school students in South Africa have highlighted the importance of mathematics teachers' content knowledge as a crucial factor influencing instructional quality and student outcomes. This study conducts a systematic review of empirical literature published from 2005 to 2025 to analyse the trends and distribution of content knowledge among mathematics teachers in South African primary schools. We employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to systematically search the Web of Science, Scopus, and EBSCOhost databases. Following the application of the inclusion and exclusion criteria, a total of 18 eligible studies were identified and analysed. Data were gathered regarding the research focus, levels of content knowledge, geographical distribution, study populations, and the effects of professional development programs. A considerable percentage of primary mathematics teachers in South Africa exhibit content knowledge that falls short of the expected teaching standards, with significant variations observed across different regions and school quintiles. While there have been some improvements in recent years, particularly among pre-service teachers and those involved in well-structured development programs, systemic issues like insufficient initial teacher training and unequal professional support continue to be significant challenges. In light of these findings, it is recommended that initial teacher education be enhanced, professional development be reconfigured to be responsive to context and sustained over time, inequities in teacher deployment and support be tackled, and longitudinal studies be encouraged to guide future interventions.

Keywords: Mathematics Content Knowledge; Primary School Teachers, Systematic Review; Teacher Education; South Africa

Enhancing Assessment in Low Resource Teaching Environments: Leveraging STACK in the African Context.

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Abstract

African universities often have large classes and limited resources, making it hard to give students enough practice and timely feedback. This affects the quality of education. As STEM subjects gain traction in the 21st Century, improving mathematics education in Africa is crucial for inclusivity. In this paper, we share practical ways (both from firsthand experience and also from other case-studies) on how to use technology to improve mathematics education in low-resource settings, especially in Africa. We focus on STACK, an open-source online assessment tool in Moodle, and how it is helping students learn mathematics. Using case studies from Kenya, Tanzania, and other countries, we show how STACK supports teaching through automated assessments, instant feedback, and data insights. We also highlight ongoing projects in Africa and explore opportunities for educators to collaborate and build a strong community. Finally, we discuss the need to involve teachers, policymakers, and stakeholders in adopting technology like STACK to improve STEM education in African institutions.

Exploring the Role of Computer Simulations in Enhancing Mathematics Learning Outcomes in a Selected Junior Secondary School in Narok Central Sub-County, Kenya

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Abstract

This study explores the role of computer simulations in enhancing mathematics learning outcomes among junior school learners in Narok Central Sub-County, Kenya. Grounded in mixed-methods, quasi-experimental design, the research aimed to investigate how computer simulations influence learner engagement, conceptual understanding, and overall perceptions of mathematics instruction. Data was collected through teacher interviews, a focused group discussion with learners, learner questionnaires, and classroom observations. Findings reveal that computer simulations significantly enhance learner engagement and understanding, particularly in topics involving spatial reasoning such as geometry, area, and volume. Teachers reported that computer simulations made abstract concepts more tangible and fostered greater learner curiosity and motivation. Learners echoed these sentiments, noting improved recall and comprehension when computer simulations were used. However, the study also highlights persistent barriers to effective implementation, including limited access to technology, inconsistent electricity supply, and varying levels of digital literacy among both teachers and learners. Despite these challenges, the overall perception of computer simulations was positive. Teachers advocated for a blended instructional approach that integrates computer simulations with traditional methods, enhancing inclusivity and catering to diverse learning needs. The study underscores the importance of investing in digital infrastructure and continuous professional development to fully realize the potential of computer simulations in mathematics education. This research contributes to the growing discourse on digital pedagogy in African classrooms and offers practical insights for educators, policymakers, and curriculum developers seeking to integrate technology in meaningful and contextually relevant ways.

Acknowledging and Addressing Barriers of Mathematics Education for an Inclusive Africa

Thabo Kgosana
Maskew Miller Learning

Abstract

Mathematics education in Africa faces persistent challenges that hinder equitable learning outcomes. This paper examines the multi-layered barriers to effective mathematics education across the continent, including inadequate resources, socio-economic disparities, cultural and language obstacles, and insufficient teacher training, and discusses strategies to foster a more inclusive learning environment. The role of technology integration, particularly through innovative ICT and AI-driven tools, is explored to bridge educational gaps. Maskew Miller Learning's AI mathematics tool, Maski, is highlighted as a case study exemplifying how adaptive learning platforms can support diverse learners and teachers. Additionally, the paper contextualizes Maski alongside other South African ICT innovations such as Siyavula and Dr. Math to illustrate the growing ecosystem of digital solutions in mathematics education. Emphasis is placed on inclusivity and diversity, ensuring that interventions address the needs of all learners, including those from marginalized communities and those with disabilities. The importance of teacher professional development is underscored, recognizing that empowering educators with the skills and knowledge to leverage technology and inclusive practices is pivotal for sustainable improvement. Through an academic review of current challenges and emerging approaches supported by examples, and frameworks, the paper offers insights and recommendations for advancing mathematics education toward a more inclusive future in Africa.

Assessing Artificial Intelligence Literacy among Undergraduate Science Education Students: Challenges and Strategies for Improvement

Maria Tsakeni & Stephen Chinedu Nwafor
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Abstract

The increasing use of Artificial intelligence (AI) despite its challenges across different disciplines including education has called for the development of AI literacy among students. Efforts have focused on its ethical considerations, awareness and accessibility to the students. Yet limited research explored the AI literacy levels of university students who are the critical consumers of AI technology. The study examined the artificial intelligence (AI) literacy of undergraduate science education students, the challenges they face in developing AI literacy and strategies to improve their AI literacy. A sequential mixed methods design which involves a systematic survey followed by a semi-structured interview was used for the study. The undergraduate Science Education Students AI Literacy, Challenges and Strategies Questionnaire (USEAILCSQ) was administered to 180 science education students using stratified random sampling to ensure valid representation across different areas of specialization. For the qualitative analysis, a semi-structured interview was done on five science education students with average AI literacy. Mean, percentage, bar chat and independent sample t-tests were used for data analysis. The findings revealed a limited AI literacy level among undergraduate science education students irrespective of their areas of specialization. The challenges faced by the students in developing AI literacy include limited support from the institution, poor understanding of AI concepts, limited lack of access to AI-driven tools, unstable power supply to power AI-driven tools and insufficient AI-related coursework. Also, the strategies identified by the students for improving their AI literacy are the provision of mentorship, workshops, integration of AI tools like ChatGPT with face-to-face learning, integrating AI into existing courses and developing new ones. The study underscores the necessity of professional development among undergraduate science education students towards AI integration in science education.

Keywords: Artificial Intelligence (AI), AI Literacy, Science Education, Undergraduate students.

Leveraging Large Language Models to Identify and Classify Student Errors in Higher Education Mathematics Using the STACK Dataset

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Abstract

STACK is an interactive digital teaching tool for STEM education. While it has helped address challenges such as large class sizes in institutions of higher learning in Africa, it lacks adaptability to individual student needs. The integration of machine learning (ML) techniques in STACK to support adaptive mathematics learning in universities has gained our attention. However, effectively identifying the types of errors learners make is crucial for developing a recommendation system that enhances both emotional and behavioral student engagement. This study explores the application of Large Language Models (LLMs), specifically OpenAI's model GPT-4o, to analyze learners' mathematical errors using the STACK dataset from Masinde Muliro University of Science and Technology (MMUST) Kenya. By leveraging AI-driven error classification and clustering techniques, we identify common error patterns in the topic "Plane Curves and Parametric Equations" within the Analytical Geometry course, involving 618 first-year university students. A total of 3,157 incorrect responses were collected from five randomized questions designed to assess a range of mathematical skills, including parametric equations, tangent equations, graphs, gradient, and differentiation which students consistently struggled with. Unlike traditional methods, OpenAI's model GPT-4o was employed to predict error types and uncover recurring patterns, enabling to derive insights through advanced data analytics. Errors were classified using Newman's Error Analysis framework, which categorizes them into five hierarchical stages: (1) reading errors, (2) comprehension errors, (3) transformation errors, (4) process skill errors, and (5) encoding errors. The distribution of identified errors showed that transformation errors were the most prevalent (67.36%), followed by comprehension errors (59.84%), encoding errors (37.48%), process skill errors (28.15%), and reading errors (1.17%). In addition to these, the analysis revealed other most common issues such as conceptual misunderstandings, incorrect numerical values, misinterpretation of notation or formatting, and sign errors. By integrating LLMs with Newman's classification model, this study highlights the potential of AI in automating error diagnosis and providing educators with deeper insights into student difficulties.

Keywords: STACK, Large Language Models, Newman's Error Analysis, STEM Education.

Impact of STEM policies on effective implementation of STEM curriculum in rural secondary schools in South Africa

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Abstract

The world is becoming increasingly complex, where success is driven not only by what you know, but what you can do with what you know. The STEM curriculum allows learners to be equipped with the knowledge and skills to solve problems, gather and evaluate evidence, make sense of information, opens the door for lifelong learning, is culturally responsive, employs problem and inquiry-based approaches and engages learners in hands-on/minds-on activities. Nonetheless, the National STEM policy provides a coherent framework for identifying and articulating STEM-specific strategies and programs spanning the schools. The qualitative approach was undertaken and deemed appropriate to explore the impact of STEM policies on effective implementation of STEM curriculum. Data was collected by means of face-to-face interviews with STEM teachers, school principals, curriculum advisors and parents in Limpopo Province. Multicultural education perspective provides the lens, taking into account diversity of learners' context, equality of opportunities and addressing discriminatory practices in the implementation of STEM curriculum. From a policy angle, it is imperative that the DBE treats the formulation of the inclusive STEM policies that can appropriately guide financial support to learners, teacher professional development, pedagogy, community engagement and providing CAPS aligned textbooks, internet, ICT infrastructure and laboratory equipment to effectively implement STEM curriculum. The DBE and Teacher Training Institutions should invest in teacher in-service and teacher pre-service to effectively train them in teaching of STEM subjects.

Keywords; curriculum, implementation, rural secondary schools, STEM policy

IMPLEMENTATION OF LESSON OBSERVATION PRACTICE IN THE LESSON STUDY CYCLE: A CASE OF MATHEMATICS TEACHERS IN CHINGOLA DISTRICT, ZAMBIA.

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University of Zambia

Abstract

This study examined the implementation of lesson observation practice in the lesson study cycle of mathematics teachers in Chingola District. The study arose from the concerns identified by Wolthius et al. (2020) regarding the limited implementation of live observation lessons in global study practices. Utilizing a mixed-methods approach, data were collected from 29 teachers, 6 Heads of Department (HODS), and 12 learners through group discussions, interviews, and questionnaires. Analysis was conducted using SPSS and NVIVO software. Findings revealed that lesson observation practice positively impacted on the learners' engagement and teachers' mentorship, enhancing lesson planning and delivery. However, challenges such as inconsistent adherence to guidelines and limited teacher collaboration hindered its overall effectiveness. The study concludes that while lesson observation practice holds potential for improving teaching and learning, its implementation in Chingola District requires refinement. Recommendations include focusing on practical application of guidelines and expanding research to other districts.

Keywords: lesson observation practice, implementation and lesson study, teacher mentorship, quality teaching.

Decompression as a tool for promoting mathematical thinking

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Abstract

Drawing learners' attention to mathematical structure is important for developing their conceptual understanding of mathematics. Using variation theory, different kinds of tasks have been developed to bring mathematical structure into focus for learners. Watson and Mason (2006) argue that carefully varied exercises (sets of examples and tasks) offer opportunity to elicit learners' thinking and can therefore be potentially used to develop hypothetical learning trajectories. Decomposition is an important strategy to make the mathematical structure explicit to the learners. For example, Ma's (2010) research on teaching arithmetic operations revealed that teachers who decomposed the larger units (for example, thousands) into smaller units (hundreds) when performing subtraction with regrouping, foregrounded the key idea of place value in the teaching of subtraction. Extending the use of decomposition to the procedures involving multiplication of three-digit numbers and division of fractions, Ma suggested that explicit reference to conceptual units helps in identifying the connections between different pieces of knowledge to create structurally woven "knowledge packages" for specific sub-topics. Zazkis and Campbell (1996) used decomposition of natural numbers to a unique set of primes, with preservice teachers, to exemplify the Fundamental Theory of Arithmetic, thus promoting an understanding of the construction of natural numbers and their multiplicative structure. For example, consider the task: if $k = 16199$, which is a product of two primes 97 and 67, then is k divisible by $3, 5, 7, 11$ or 13? The findings signaled the importance of understanding uniqueness and independence of order through decomposition to develop an understanding of the structure of whole numbers. While decomposition as a strategy has been used in arithmetic extensively, its use has been extended to bridging the transition from arithmetic to algebra. Hernandez and Kieran (2020) used the strategies of decomposing, composing and recomposing with primary school learners for validating truth of numerical equations such as, $5 + 8 + 13 = 12 + 8 + 6$, further extending these to numeric equations involving addition of large numbers. In this paper, we propose *decompression* as a way of making mathematical structure visible through carefully varied tasks. We suggest that decompression is a process

which involves connections between decomposition and re-representation, and together these can be used to make the mathematical structure visible. To substantiate our proposal, we will discuss tasks, designed using variation theory, from different domains within elementary mathematics, to show how decompression helps in promoting structural thinking. Further, we will suggest that decompression tasks create opportunities for making the big ideas within a domain accessible to learners. Some examples of tasks from arithmetic, algebra and basic geometry are provided in Figure 1. The design principles and the affordance of these tasks for pedagogical purposes will be detailed in the presentation.

1. Make 10 in different ways using the following conditions:
   (a) Adding two whole numbers
   (b) Multiplying two prime numbers
   (c) Subtracting two fractions
   (d) Using any operation between two square numbers
   (e) Using two rational numbers

2. Read the factorization of a trinomial and answer the questions below.

   Factorise: $x^2 - 5x + 6$

   $$= x^2 - 2x - 3x + 6$$
   $$= x(x-2) - 3(x-2)$$
   $$= (x-2)(x-3)$$

   (a) Which term of the expression is decomposed?
   (b) How is this term re-represented and why?
   (c) Check whether all the steps of the factorization are different ways of rewriting the same expression.
   (d) Use the same method of decomposition and re-representation to factorise: $n^6 + 12n^3 + 35$.

3. Which of the following are correct ways of rewriting $((gh)^2)^3$?
   (a) gh^6
   (b) $(gh \times gh \times gh)^2$
   (c) g^3h^6
   (d) $(g \times g \times h \times h)^3$
   (e) $(g^2)^3 \times (h^2)^3$

Figure 1: Example of tasks involving decomposition

Analysing the meanings of contextualization through a study of curricular materials

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Abstract

Contextualization carries a range of meanings shaped by historical, cultural, and pedagogical shifts. While often interpreted as a pedagogical approach, the idea of contextualization has come to signify broader questions about curriculum design, epistemic inclusion, and the politics of knowledge representation. This paper undertakes a conceptual and curricular analysis of contextualization, foregrounding diverse ways in which it is articulated and operationalized within mathematics education materials. It traces the conceptual evolution of contextualization across disciplines and explores its manifested meanings through a close examination of three alternative curriculum materials from India. The study highlights the multiple dimensions of contextualization as a didactical pedagogical strategy, as a process of integrating lived experience into disciplinary domains, and as a curricular stance that influences what is taught, how it is taught, and to whom. Through examples ranging from regionally grounded initiatives to nationally prescribed textbooks, the paper interrogates how contextualization mediates learners' access to mathematical understanding, and how curricular decisions reflect tensions between local relevance and disciplinary universality. By using critical mathematics education (CME) as a theoretical framework, the paper argues for a more nuanced and robust engagement with the mean(ing)s of contextualization, which go beyond surface-level applications and addresses the structural and ideological dimensions of curriculum. In doing so, it invites mathematics educators and curriculum developers to reconsider the purposes and practices of contextualization in mathematics education.

Keywords: Contextualization, Critical math education, Curricular materials, Meaning making, Texts

A Back-and-forth View of Indigenous and Modern Systems for Mathematics Educators' Professional Developments

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Abstract

This writing of this paper is based in culturally grounded mathematics education and teacher development. It is noted that the ultimate goal of facilitating teacher's professional development program (e.g. Lesson Study) is to promote learning at all levels. The four pillars of Learning (UNESCO, 1996): to know, to do (practical), to be (becoming, being), and to live together have been foundational in schooling. Then, how these pillars could be contextualized in a life-long professional learning? A qualitative content analysis was employed in this study. From the audio- video recordings available in the social Medias and published reading materials, there are key principles with potential implication for collaboration among the members of professional development networks. Currently, differentiated instruction and self-paced learning have got consideration. This had been common in the classical education systems of Ethiopia. This paper presents a re-conceptualization of Yeneta'wi pedagogy in the contemporary education and training programs. It explores the interplay between indigenous knowledge systems and modern educational approaches in mathematics education. Some of the results worth to mention here are: principles of individual pace learning, collaboration, inclusiveness, kindness, resilience, hardworking, kindness, focus/patency/inspiration and reflective thinking. The investigation is in line with the pursuit of multi-level teaching which exists in other countries, too; it can be considered as an optimal strategy and practice to reverse negative trends in rural education, and to enable access, equity and quality of education in previously neglected areas. Finally, a tiered ladder of professional learning is forwarded. This paper has brought implications for educator and researcher professional development.

Keywords: cultural responsiveness, decolonizing education, multi-level professional learning

Noticing to Know and Inform Action: Using Professional Noticing and Error Analysis to Strengthen Mathematics Teaching

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Abstract

This workshop introduces participants to the practice of professional noticing as a means of improving teacher responsiveness to learner thinking. Grounded in the frameworks of mathematics knowledge for teaching (Ball et al., 2008) and professional noticing (Jacobs et al., 2010), and supported by Vygotsky's (1978) sociocultural theory of learning, the session uses authentic South African classroom videos to examine learner errors and misconceptions in topics such as directed numbers and elementary algebra. Teachers will learn to attend to, interpret, and respond meaningfully to learner thinking, using learner errors not as deficits, but as diagnostic tools for informed instructional action.

Exploring the Development of Technological Pedagogical Mathematical Knowledge (TPMK) in Multilingual Preservice Teachers

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Abstract

The integration of technology in mathematics education requires teachers to develop Technological Pedagogical Mathematical Knowledge (TPMK) to effectively create opportunities for learning. This study explores the development of TPMK in multilingual preservice teachers (PSTs). It examines how the language of learning and teaching (LoLT) and the mathematical language influence the PSTs' ability to integrate technology in their explanation of mathematical concepts. The study employs the TPMK in context framework which is a modification of the TPACK framework, which also guides the analytical framework. Through an analysis of PSTs' questionnaires, presentations, and short interviews, the study identifies key challenges related to the use of mathematical terminology, language barriers, and the traditional use of technological tools. Findings reveal that PSTs often struggle to articulate mathematical concepts due to linguistic difficulties, leading to the avoidance of terminology and a reliance on demonstration rather than conceptual explanation. Additionally, the influence of the LoLT impacts the depth of mathematical reasoning in their instructional approaches. In spite of these findings, the upside of the PSTs development of TPMK is that they are eager to engage with technological tools and therefore find it easy to navigate them. This creates a good base from which teacher training can move the PSTs from just knowing how to use the tools, to integrating them in their teaching. The findings emphasize the importance of language-sensitive and technology-enhanced instructional strategies in teacher training to support the development of TPMK in PSTs.

Keywords: Preservice teachers, multilingual classrooms, contextual knowledge, technological
tools

Systematic literature review: Difficulties in utilising suggested teaching techniques in mathematics classrooms

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Abstract

The study examined how different teaching strategies or approaches are applied by educators as they teach mathematics. This was accomplished by reviewing various articles. Essentially, the following research tools were used to obtain different articles that contributed to this study: Google Scholar, Sabinet, Science Open, JSTOR, Springer, ScienceDirect, ERIC, ResearchGate, and UJ library. The articles from various tools were reviewed by following the PRISMA guidelines of systematic literature review and analysis. Most importantly, findings outlined that essential techniques for teaching mathematics are explained in various studies. These include procedures on how to implement them during teaching and learning. However, the majority of educators ignore the suggested techniques such as problem-based learning, project-based learning, collaborative learning, and game-based learning. Such innovative techniques are not considered due to the following reasons: some educators claim that they consume time, and some lack skills of how to apply them. Despite that, some educators are dedicated and ready for the change within the department of Education, and some still have issues integrating technology into mathematics. Hence, we suggest that evidence of utilising learner-centred techniques must be submitted every term to ensure that appropriate techniques for teaching mathematics are applied. Subsequently, attending mathematics conferences should be compulsory for all mathematics educators. This will enhance their conceptual and pedagogical knowledge. Moreover, this will be a strategy of ensuring that each educator takes responsibility of their actions.

Keywords: teaching strategies: collaborative learning, Problem-Based learning, Project-based learning, pedagogical and content knowledge.

Effect of Mathematics Pedagogical Simulation Methods on Mathematics Attainment of Grade Three Children in Loitokitok Sub-County, Kajiado County, Kenya

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University of Nairobi

Abstract

Based on Gardner's theory of multiple intelligence which argues against biased instruction, the study sought to investigate the effects of different types of mathematics pedagogical simulation methods on the mathematics achievement of grade three children. The study adopted a quasi-experimental research design. The study sample size was 1842 participants selected by stratified random sampling. Data collection tools included pre-tests, post-tests, and classroom observation questionnaires. Quantitative data were analysed using the quantitative statistical approach and the Pearson Chi-Square test while qualitative data were analysed thematically. Ethical considerations included signing an informed consent form. The study showed that the percentage of above-average attainment in the experimental group increased from 62.30% to 92.90%. The study found that different types of mathematics pedagogical simulation methods resulted in positive attitudes and significantly improved mathematics attainment. The study recommends the inclusion of different types of mathematics pedagogical simulation methods in the grade three children mathematics curriculum, ongoing teacher professional development training on non-routine mathematics pedagogical simulation strategies, flexible supportive mathematics teaching and learning policies, and further research on the long-term effects of the mathematics pedagogical simulation methods, especially in the affective domain, so that no child is left behind in the learning in the mathematics classroom. These strategies can promote children's engagement and improve mathematics outcomes in early primary schools. Multiple intelligence-based mathematics learning gives children who are gifted in areas other than logical-mathematical intelligence the opportunity to fully utilize their competency-based minds and abilities in mathematics learning.

Keywords: Types of mathematics pedagogical simulation methods; mathematics attainment; positive disposition

LEARNERS' CONCEPTUAL UNDERSTANDING OF THE VERTEX FORM OF A QUADRATIC FUNCTION: A CASE OF THE VERTEX AND PARABOLA CONCEPTS

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Abstract

This study explores Grade 12 learners' conceptual understanding of the vertex form of a quadratic function through the Activities, Classroom Discussion, and Exercises (ACE) teaching cycle. Grounded in Dubinsky's APOS theory, the research examines learners' conceptual progression in understanding the vertex and parabola concepts. Using a qualitative case study approach while incorporating the ACE teaching cycle, data were collected through activities, classroom discussions, and exercises, focusing on four participants out of 20. The findings reveal that many learners operate at the action and process levels, struggling to transition to a fully developed object or schema-level understanding. Key misunderstandings include confusing the vertex with function parameters, misinterpreting the axis of symmetry, and an overreliance on procedural methods. The study highlights the critical role of structured interventions, such as the ACE cycle, in enhancing conceptual clarity. A revised genetic decomposition model is proposed to address learning gaps and foster deeper mathematical reasoning. The study concludes that strengthening the conceptual grasp of the vertex is essential for developing a robust understanding of the parabola concept.

Keywords: Conceptual understanding, APOS theory, Quadratic functions, ACE cycle, Vertex,
Parabola

Reimagining collaboration: a zone-based analysis of mathematics teacher educators' learning in Ghana

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Abstract

This qualitative case study examines how Professional Learning Communities (PLCs) facilitate the professional development of Mathematics Teacher Educators (MTEs) in resource-constrained contexts, specifically within a Ghanaian teacher training institution. Drawing on Valsiner's (1997) zone theory integrated with Goos' (2014) Teacher Educator as Learner (TEasL) framework, the research investigates collaborative practices that support MTE growth and their perceived impact on professional learning. Four MTEs participated in this six-month study through semi-structured interviews, focus group discussions, and observations of weekly PLC sessions. Thematic analysis revealed four core collaborative practices that transformed zone interactions: practice-based experience sharing, reflective practice cycles, team teaching, and demonstration lessons. These practices created dynamic configurations of the Zone of Proximal Development, Zone of Free Movement, and Zone of Promoted Action that fostered professional learning despite institutional constraints. The findings demonstrate that deliberate collaborative practices can effectively combat professional isolation, while enhancing pedagogical understanding through collective meaning-making. Participants reported substantial improvements in their teaching practices and reduced professional isolation. The study reveals how PLCs can function as ecosystems where zone interactions are continuously negotiated, creating "collective zones of development" that amplify individual learning potential. Significantly, this research challenges prevailing assumptions about necessary conditions for effective professional development by demonstrating that strategic orchestration of collaborative practices can cultivate productive learning environments without additional material resources. The intellectual and experiential capital within educational communities proves more transformative than external expertise or funding. The zone-based analysis offers a theoretically grounded framework for understanding how collaborative practices mediate professional learning in mathematics teacher education. This framework provides practical guidance for designing sustainable professional development programs, particularly in

developing educational contexts where formal support structures are limited. The study contributes to the global discourse on MTE development by demonstrating that meaningful professional growth is achievable through thoughtfully designed collaborative structures that leverage existing human capital and collective wisdom within educational communities.

Keywords: Mathematics teacher educators, professional learning communities, collaborative practices, professional development, zone theory, professional isolation

Learner variability in statistical interpretations

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Abstract

Access to mathematical concepts has for long been a major talking point all over the world. One of the major barriers to effective and meaningful mathematics learning is errors emanating from misconceptions. This study identified the concept of data variability as one area in which learners hold a lot of misconceptions. Arguably, there is not much literature on misconceptions in statistics education, particularly at school level. Thus, the present study examined the nature of errors which arise from misconceptions which learners hold particularly in representing and interpreting variability of data via ogives, frequency polygons and box plots. Moreover, the study sought to establish the extent to which a teaching intervention of Multiple External Representations (MERs) could assist in error minimisation. Using ideas of constructivism and sociocultural theory, the study involved a group of eighteen Grade 11 learners and the researcher. It was conducted at a Gauteng township high school. The researcher was involved in the delivery of ten lessons on statistical diagrams, and two tasks were assigned to learners prior to as well as after conducting a constructivist-based intervention lesson. The rationale for conducting the lesson was to determine the extent to which remediation could assist in minimising incidences of these errors. In addition, four learners were interviewed to have an idea on the thinking behind errors committed.

The study found that most errors made by learners emanated from application of irrelevant prior knowledge (conceptual) which led to the use of unsuitable methods (procedural). Interview data exposed misconceptions possibly due to poor language proficiency.

The study recommends that teachers should always use appropriate language of teaching and learning all the time so as to enable learners to improve their communication skills as well as enhance understanding of statistical concepts. Moreover, it is recommended that future studies be carried out on statistical content knowledge of teachers as this could be yet another source of misconceptions held by learners in statistics.

Keywords: Error, misconception, teaching intervention

Mathematics teachers' perceptions of AI as a pedagogical tool: responding to the new culture of learning.

Fanuel Matindike & Virendra Ramdhany

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Abstract

Mathematics teachers' perceptions of AI as a pedagogical tool: responding to the new culture of learning Abstract This paper reports on an ongoing study that aims to examine mathematics teachers' level of understanding, their perceptions, and their experiences of AI as a pedagogical tool. The study used a descriptive survey approach, which saw high school mathematics teachers in Gauteng province of South Africa completing an online questionnaire. Artificial intelligence (AI) has exploded in the years leading up to the COVID-19 pandemic and beyond, and the education system is not immune to this novel innovation. Inevitably, teachers' responses to AI systems and applications vary depending on their pedagogical philosophies, teaching experiences, and technological efficacy, which in turn influence their desire to accept new educational technology. Data collected will be analysed using SPSS and the study is expected to uncover the teachers' perceptions, expectations, fears and challenges in their use of AI, which will in turn inform efforts and investments towards advancing AI in the school system. The study is also expected to reveal variables that influence teachers' perspectives and their usage of AI in their teaching.

Using immersive virtual- reality based headsets to train pre-service education students for professional understanding of content

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Abstract

Preparing pre-service teachers to teach in a technology driven world requires them to gain digital competencies to face the challenges of the 21st century classroom. However, Universities in South Africa, are governed by policy dictates of Minimum Requirements for Teacher Education Qualifications (MRTEQ), which limits Teaching Experience to being school based only. There is lack of empirical research exploring the influence of using Immersive Reality (IVR) in science teaching at universities. To address this gap this research identifies and outlines how the use of Immersive virtual reality headsets enhances pre-service teacher's content knowledge on the topic of photosynthesis.

A true experimental research design was conducted to measure if academic performance and engagement with technology improved the understanding of the content. This study is guided by the research question: How can the use of immersive virtual reality-based headsets be used to train preservice teachers to improve professional understanding of content. This study will follow Shulmans (2005) pedagogical content knowledge (PCK) as its theoretical framework; however, it will be enhanced with the inclusion of technological, pedagogical content knowledge (TPCK) (Niess, 2009).

The results revealed that using IVR as a learning supplement to the conventional method of teaching content could improve student's learning, particularly for low spatial ability students. This study provides empirical evidence for IVR's use in science education. Furthermore, it sheds light on the need for improvement to the MRTEQ policy to include the use of digital tools when training teachers. It also elucidates how to develop and implement an IVR- based classroom for formal educational purposes.

Developing Mathematics Student Teachers' Professional Knowledge: The Role of Habitus and Cultural, Social, and Economic Capital

Bheki Zungu
University of the Witwatersrand

Abstract

This conceptual paper examines how mathematics student teachers in a South African university navigate their professional learning within a higher education landscape shaped by dominant western cultural norms. Using Pierre Bourdieu's theoretical tools habitus, field, cultural capital, social capital, and economic capital, the paper interrogates how student teachers' everyday experiences reflect struggles for legitimacy, recognition, and belonging in academic spaces that often marginalised non-dominant cultural identities. Many student teachers enter the university with fixed ways of knowing shaped by their socio-economic backgrounds and local communities, which may be misaligned with the expectations and values embedded in the institutional culture of the university. This imbalance produces tensions as students negotiate their developing professional identities within a field that privileges western epistemologies and forms of capital. The paper argues that understanding the role of habitus in this navigation process is critical for designing teacher education programs that are socially just and inclusive to the lived realities of South African students. By foregrounding the interplay between structure and agency, the paper proposes a framework for mathematics teacher education that values and leverages the diverse cultural, social, and economic resources student teachers bring into the field.

Keywords: Mathematics education, teacher education, habitus, cultural capital, field, economic capital

Symposium: Valid and reliable South African tools for identifying mathematics learning difficulties

Hanrie Bezuidenhout, Kathleen Fonseca, Catherine Nedambale & Gladys Tshikondela
University of Johannesburg, University of Venda

Abstract

Early numeracy is generally regarded as the best cognitive predictor of later mathematics performance (Bezuidenhout, 2018; Fonseca et al., under review; Purpura et al., 2017). Early numeracy is a multifactorial construct consisting of an understanding of numerical relations, basic arithmetic, procedural counting, counting knowledge, and symbolic and nonsymbolic number representations, and mathematics vocabulary (Aunio & Räsänen, 2016; Purpura & Lonigan, 2013; Schmitt et al., 2019). Yet, it is not clear if early numeracy as a unitary construct, or one specific component of ealry numeracy is the best predictor of later mathematics performance. To address this question, valid and reliable instruments are needed to establish the predictive value of numeracy and its individual components (Bezuidenhout et al., 2025).

In this symposium we will present two valid and reliable South African numeracy tests and discuss the translation of the instruments into several South African languages. First, we will show how one component of numeracy, namely mathematics vocabulary, predicts mathematics performance longitudinally by using the Mathematics Vocabulary Test (Bezuidenhout et al., 2025), available in five South African languages. Secondly, predictive validity data of the English translation of the Finish Thinkmath assessment (Ragpot et al., 2016; Aunio et al., 2019), shows that three individual factors of early numeracy, namely counting, arithmetic and numerical relations, and also numeracy as a unitary construct, are reliable predictors of mathematics learning difficulties (MLD) (Fonseca et al., in progress). Lastly, two early grades teachers will discuss the applications of these tests and their translations when used in classrooms where children learn in their home language, compared to second language learners. We conclude that although individual components and early numeracy as a unitary construct are reliable predictors of MLD, the best possible predictor are dependent on age and environmental factors. The symposium consists of three presentations and a discussion.

First presentation: Development of a Mathematics Vocabulary Test: Evidence of Validity and Reliability in a Multilingual Context

Hanrie Bezuidenhout
University of Johannesburg

Abstract

The aim of our study was to develop the Mathematics Vocabulary Test (MVT) - an instrument to identify young children with a limited mathematics vocabulary. This study consists of two substudies with children aged 3 - 8.5 years (N=988, ngirls = 429). In Study 1, a 26-item Mathematics Vocabulary Test (MVT) was developed by multi-professional expert panels and piloted in four languages, isiZulu (n = 229), Sesotho (n = 83), English (n = 89) and Afrikaans (n = 216). Study 1 provided evidence of content validity and the MVT was further revised, based on the results. In Study 2, additional samples were assessed with the revised version of the MVT in English (Stage 1, n = 270) and isiZulu, (Stage 2, n = 101) to provide further evidence of reliability and validity for these two language versions of the test. Confirmatory factor analyses supported structural validity of a unidimensional structure, including 20 items in the English version and 16 items in the isiZulu version. The structure of the English MVT showed stability across time (T2 5 months after T1) as well as predictive validity. Both versions showed good concurrent validity. We conclude that the English and isiZulu MVT can be used as a measure of mathematics vocabulary in educational practice and research with young children.

Second presentation: Individual differences in predicting mathematical learning difficulties in South African school beginners

Kathleen Fonseca

University of Johannesburg

Abstract

The aim of this study was to investigate the individual differences in predicting at risk for mathematical learning difficulties in South African 6-7 year-old children. Longitudinal data with two measurement points was collected with 435 children (229 girls, 206 boys). Early numeracy skills were assessed using an English version of the ThinkMath test which includes tasks measuring numerical relational, counting and simple arithmetic word problem skills. The results showed evidence of a 3-factor and 1-factor structure of the measurement across time, good internal consistency and test-retest reliability. To produce evidence of known group validity, the results also showed stability in an at-risk classification for mathematical learning difficulties between ThinkMath scores at time point 1, teacher ratings, and ThinkMath scores at time point 2. The study showed that the ThinkMath instrument can be used to identify children with mathematical learning difficulties.

Using the Mathematics Teaching Framework to design opportunities for deepening understanding of mathematics

Craig Pournara & Rencia Lourens
UNiversity of the Witwatersrand

Abstract

The Mathematics Teaching Framework (MTF) was developed by the Wits Maths Connect Secondary project (WMCS) as a resource for studying and designing teaching opportunities, ranging from individual tasks to entire lessons. The MTF now forms a central part of the professional development work that has emerged from WMCS, and it is being used in SA, in other parts of Africa, the UK and the Philippines.

In this workshop we will present the 4 main components of the MTF (lesson goal, exemplification, explanatory communication and learner participation). Participants will have opportunity to work with the MTF components, together with the principles of variation theory. There will be opportunity to share and critique example sets and explanations produced by participants and hence opportunity to work together in a collegial, interactive environment.

Length of workshop: 90 minutes

Target audience: Senior primary & secondary mathematics teachers, mathematics teacher educators

Third presentation: The translation and implementation of an early numeracy test in four South African languages

Catherine Nedambale & Gladys Tshikondela
University of Venda, University of Johannesburg

Abstract

In a multilingual country such as South Africa, reliable and valid instruments are needed to assess children's early numeracy in several official languages. Reliable translations of early numeracy tests can be used in classes where children learn in their home language (e.g. Tshivenda, isiZulu, Sesotho) or in classrooms where these children learn in an additional language, namely English. These diverse learning environments pose various challenges in terms of validation of an instrument. In the presentations of the ThinkMath and MVT tests, we included home language learners from various groups: Afrikaans, Tshivenda, Sesotho, and isiZulu first language learners; as well as Tshivenda, Sesotho and isiZulu children who learn mathematics in English. We worked with these samples to compare the outcomes of L1 and L2 participants. In our presentation we will describe the translation process and challenges of implementing an assessment instrument with home language and second language samples of participants. We conclude that number concept development test outcomes of early grade learners are associated with their understanding of the language in which the test is conducted, and that the testing language is therefore a vital consideration in a multilingual country where the home langauge often differs from the school language.

Learner Errors as Windows into Mathematical Understanding: Enhancing Teaching through Professional Noticing

Judah P. Makonye
University of the Witwatersrand

Abstract

The author argues unless we begin to consciously relook into our practice we cannot transform our teaching. On the basis of Philipp's (2010) framework of professional noticing and Wallace's (2000) insights on "hearing students," I argue that effective teaching begins with a deliberate attentiveness to learners' mathematical reasoning, especially when it diverges from canonical forms. Davis's (1997) notion of "listening for differences" further supports this stance, emphasizing the interpretive posture teachers must adopt to recognize the value in unexpected student responses. In relation to these ideas, the Mathematics Knowledge for Teaching (MKT) (Ball, Thames & Phelps, 2008)'s domains of Knowledge of Content and Students (KCS) and Specialized Content Knowledge (SCK), provide a foundation for understanding how teachers can use their mathematical and pedagogical expertise to respond meaningfully to interpreted learner thinking. Makonye's research on learner errors and misconceptions in mathematics for more than 15 years centres on resourcing student mistakes as pedagogical entry points rather than obstacles in teaching mathematics. Together, these perspectives advocate for a shift in teacher practice—from evaluating correctness to interpreting meaning—thereby fostering more responsive and equitable mathematics instruction.

Challenges and affordances of teaching mathematics in the 21st Century

Kakoma Luneta
University of Johannesburg

Abstract

Educational difficulties in mathematics education in Africa are diverse. Research shows that the challenges experienced in mathematics education are a by-product of those in education in general, and these span from policy, curriculum, instruction, learning, and information technology to infrastructure. Earlier commissioned studies by the World Bank revealed that there is a growing recognition that countries in sub-Saharan Africa (n = 48) need to improve their performance in the science, technology, engineering, and mathematics subjects if they were to grasp their full latent potential in a competitive global market that is increasingly shaped by the new technologically dependent world order. This seminar culminates from Luneta (2022) that endeavoured to document recently identified special challenges in mathematics education in Africa revealed in research over the past two years. Fifty- eight articles were reviewed, of which seven papers provide annotation of major findings of outstanding interest. The presentation will cover the affordances as well as the challenges of mathematics and mathematics instruction in Sub Sahara Africa.