31st Annual Conference of the Southern African Association for Research in Mathematics, Science and Technology Education

17 –19 JANUARY 2023

Conference Theme:

Intersecting Research, Policy and Practice for a Sustainable Praxis in Mathematics, Science and Technology Education:

New possibilities and directions for the post-COVID-19 Pandemic Era

FULL CONFERENCE PROGRAMME

Hosted by the University of the Free State

SAARMSTE
Southern African Association for Research in Mathematics, Science and Technology Education

Contents

SPONSORS and venue key 3
SAARMSTE PRESIDENT'S ADDRESS AND WELCOME 5
SAARMSTE COMMITTEES 2022-2023 6
PLENARY SPEAKERS 7
WELCOME MESSAGE FROM THE CONFERENCE CHAIR 10
GUIDELINES FOR PAPER SUBMISSION AND PRESENTATION 12
REVIEWING PROCESS – SAARMSTE LONG PAPERS 2023 13
31ST SAARMSTE CONFERENCE 2023 –SUMMARY SLIDE COMPETITION 14
31ST SAARMSTE CONFERENCE 2023 –PROGRAMME 14
SAARMSTE 2023 ABSTRACTS 27
MATHEMATICS SYMPOSIA 28
SCIENCE SYMPOSIA 29
MATHEMATICS LONG PAPERS 30
MATHEMATICS SHORT PAPERS, SNAPSHOTS AND POSTERS 34
SCIENCE – LONG PAPERS 54
SCIENCE – SHORT PAPERS, SNAPSHOTS AND POSTERS 58
TECHNOLOGY – LONG PAPERS 89
TECHNOLOGY – SHORT PAPERS 90
CONFERENCE PARTICIPANTS- HYBRID 94

SPONSORS AND VENUE KEY

The SAARMSTE Executive Committee would like to thank the following sponsors for their support of SAARMSTE activities. The sponsors make it possible for SAARMSTE to sustain the development of mathematics, science and technology education researchers in southern Africa









VENUE KEY:

143: New Education Building Auditorium: Official Opening; Plenary Presentations; AGM Meeting; Closing Ceremony

143: New Education Building, Rooms 12, 13 and 15: Programme Parallel Sessions

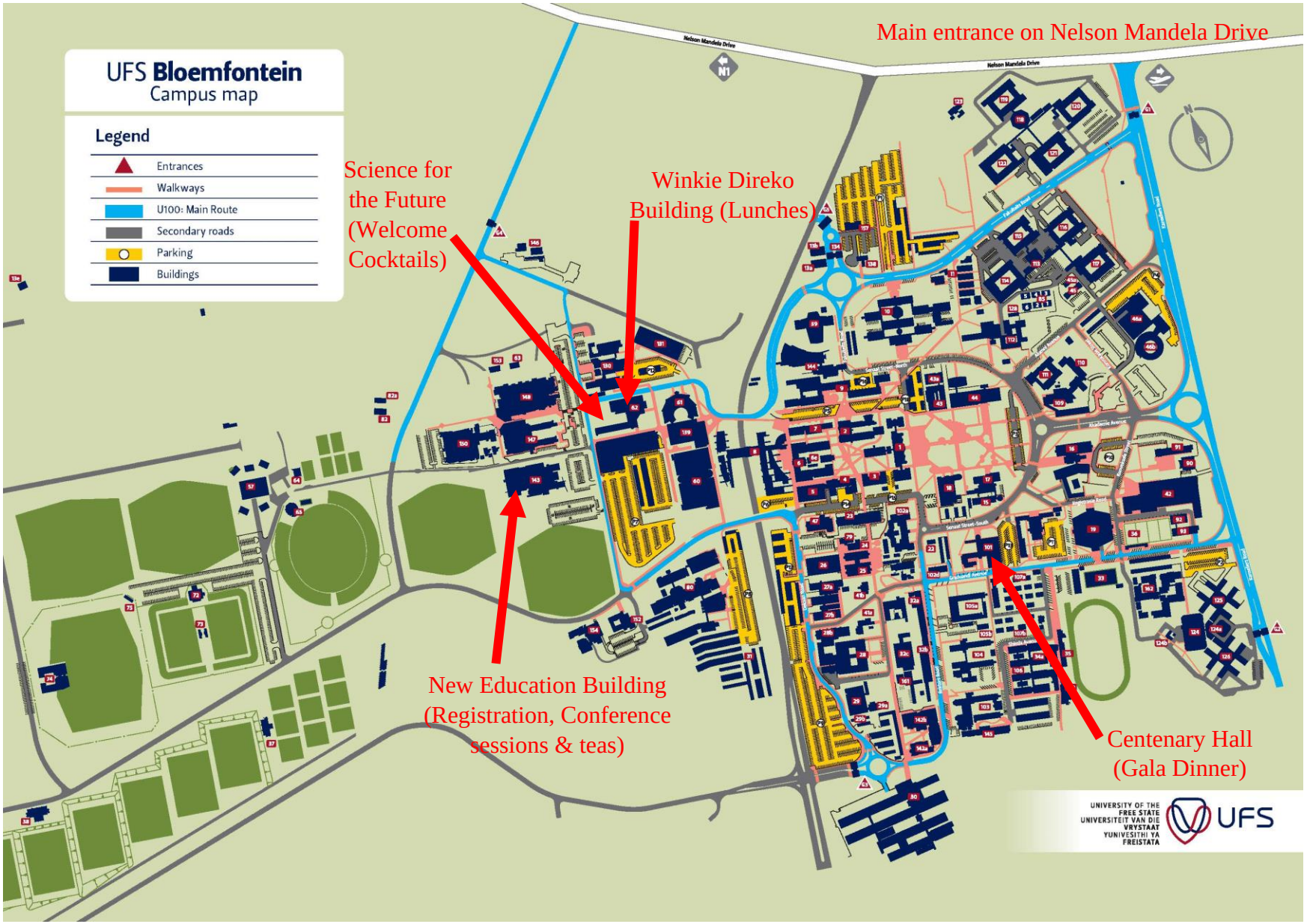
143: New Education Building Foyer: Delegate Registrations; Coffee / Tea Breaks

62: Winkie Direko Building: Lunches (Rooms 144, 145 & 147)

101: Centenary Hall: Gala Dinner / Awards

Science for the Future Building: Welcome Cocktails, Meet & Greet

(Next to Winkie Direko. Map is too old to show this new building)


UFS Bloemfontein
Campus map
Legend
Entrances
Walkways
U100: Main Route
Secondary roads
Parking
Buildings
Main entrance on Nelson Mandela Drive
Science for the Future (Welcome Cocktails)
Winkie Direko Building (Lunches)
New Education Building (Registration, Conference sessions & teas)
Centenary Hall (Gala Dinner)
UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
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SAARMSTE PRESIDENT'S ADDRESS AND WELCOME

After two years of hosting the SAARMSTE conference virtually, I am pleased that we can host a SAARMSTE Hybrid conference for the first time. It gives me great pleasure to welcome you to the city of Roses, Bloemfontein.



The SAARMSTE conference is an international conference, and I want to take this opportunity to welcome delegates from America, India, Australia, and Europe.

I want to welcome our Keynote speakers:

1. **Professor Dr Susanne Prediger,** Director of the newly established DZLM, the German National Center for Mathematics Teacher Education. The first institution of its kind in Germany, it seeks to establish a subject-specific research base for PD and facilitator preparation programs, in close cooperation with the educational authorities on national level, state and district level.
2. **Dr Gillian Roehrig** a Professor of STEM Education at the University of Minnesota. Her research explores issues of professional development for K-12 science teachers, with a focus on the implementation of integrated STEM learning environments and induction with mentoring of beginning secondary science teachers and,
3. **Professor Mishack T Gumbo** a Research Professor of Indigenous Technology Knowledge Systems Education in the Department of Science and Technology Education at the University of South Africa. His extensive publications cover peer-reviewed journal articles, conference papers, book chapters, and books.

Their presence at the conference will catalyse robust discussion on Science, Technology, Engineering and Mathematics education.

The LOC, under Dr Maria Tsakeni, has worked tirelessly to ensure that the first Hybrid conference will run smoothly and that the meeting will run smoothly. I am thus most appreciative to every member of the LOC.

The theme of this 31st SAARMSTE Conference is *Intersecting Research, Policy and Practice for a Sustainable Praxis in Mathematics, Science and Technology Education: New possibilities and directions for the post-COVID-19 Pandemic Era*. This conference is fertile ground for each one of us to have an opportunity to share best practices, discuss common challenges experienced during the Pandemic, and celebrate how these challenges were overcome. It is only through our reliance and strength that we have succeeded, and because of our experiences, we can grow and innovate to be better prepared for any further challenges.

SAARMSTE, after 31 years, is a leading STEM organisation and can only grow from strength to strength through your continued interest and support.

To all the delegates, whether you are physically present or virtual, I want to thank you for your participation and trust that the 2023 SAARMSTE conference will be memorable.

Tulsi Morar

SAARMSTE President

SAARMSTE COMMITTEES 2022-2023

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Secretariat (ex-officio):	Ms Carolyn Stevenson-Milln	SAARMSTE

SAARMSTE LOCAL CONFERENCE ORGANISING COMMITTEE (LOC) - 2023

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	Dr Thuthukile Jita
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	Dr Gilbert Pule
Science	Prof Jannie Pretorius
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	Dr Tafirenyika Mafugu
Technology	Dr Nixon Teis
	Dr Benjamin Seleke
	Mrs Zaynab Mobara-Links

PLENARY SPEAKERS

Professor Dr. Susanne Prediger - German National Center for Mathematics Teacher Education, Germany

Susanne Prediger is Full Professor for Mathematics Education Research and PD research at TU Dortmund University in Germany since 2006. Since 2021, she is director of the newly established DZLM, the German National Center for Mathematics Teacher Education which is the first institution of its kind in Germany, seeking to establish a subject-specific research base for PD and facilitator preparation programs, in close cooperation with the educational authorities on national level, state level and district level. Her research on the classroom level focuses on dealing with diversity and developing conceptual understanding, and on the PD level she investigates how to professionalize teachers for these classroom demands. She was involved in three international projects and leads several national research projects. Her international standing is documented by her position as former president of the European Society for Research in Mathematics Education and as Co-Editor-in-Chief of Educational Studies in Mathematics.

Plenary Title and Abstract:

Fostering students' understanding of procedures and underlying basic concepts: Design research for mathematics classrooms and teacher professional development in the post-pandemic era.

Although providing all students with rich and deep mathematical learning opportunities is a common request in mathematics education, many students are still only exposed to superficial learning. This was aggravated during the pandemic school closures, but continues in the post-pandemic era, as long as mathematics teachers are not sufficiently supported and prepared.

In our project *Mastering Math*, we have designed curriculum materials for fostering struggling students' understanding of mathematical procedures and the underlying basic concepts, with topic-specific design research that combines two aims, iteratively designing deep mathematical learning opportunities and investigating the initiated teaching-learning processes for increasing our understanding of conditions and mechanisms of deep and superficial learning. In a large intervention study, the Mastering Math approach was shown to be effective.

However, large differences occur between different teachers, so design research is also lifted to the professional development (PD) level, for iteratively designing PD opportunities and investigating the initiated processes of professional growth for identifying conditions to prepare mathematics teachers for initiating deep learning with the *Mastering Math* curriculum. Also on the PD level, an evaluation study revealed effectiveness for increasing teacher expertise. In the talk, I will present steps from our 16-year-long design research journey and discuss critical aspects.

Dr Gillian Roehrig - University of Minnesota

Gillian is a professor of STEM Education at the University of Minnesota. Her research explores issues of professional development for K-12 science teachers, with a focus on implementation of integrated STEM learning environments and induction and mentoring of beginning secondary science teachers. Her work in integrated STEM explores teachers' conceptions and implementation of STEM, curriculum development, and student learning in small groups during STEM lessons. She has received over $50 million in federal and state grants and published over 120 peer-reviewed journal articles and book chapters. She is a former president of the Association for Science Teacher Education and currently serves as president of NARST

Plenary Title and Abstract:

The Hows and Whys of Integrated SEM Education

Integrated STEM education is a global phenomenon with countries across the world engaged in efforts to engage students in interdisciplinary approaches to science learning. Yet, there is still no one accepted definition of integrated STEM instruction. There are some areas of agreement regarding integrated STEM: (a) the inclusion of an authentic, real-world context; (b) explicit connections between science, technology, engineering, and mathematics; (c) an understanding of different STEM career pathways; (d) intentional development of 21st century competencies; and (e) an emphasis on student-centered pedagogies. This talk will explore the development of a conceptual and curricular framework for integrated STEM and the benefits of using interdisciplinary approaches to address the policy goals of preparing students as STEM literate citizens and for the future STEM workforce.

Professor Mishack T Gumbo – University of South Africa

Mishack is a Research Professor of Indigenous Technology Knowledge Systems Education in the Department of Science and Technology Education at the University of South Africa. His extensive publications cover peer-reviewed journal articles, conference papers, book chapters, and books. His recent edited book is *Decolonization of Technology Education: African indigenous perspectives* (2020). He leads research projects and mentors developing and emerging academics in his College of Education and other institutions in Africa. He has mentored Postdoctoral Fellows since 2015. He has delivered numerous keynote addresses in seminars, colloquiums, and conferences as well as participated in panel discussions. He has supervised 21 doctoral students and 9 master's students and examined dissertations and theses for numerous universities locally and internationally. He has examined dissertations and theses for several universities locally and internationally and reviewed articles for journals and conferences. He serves on various academic committees and boards locally and internationally. He is Editor-in-Chief of Indilinga: African Journal of Indigenous Knowledge Systems. In recent years, Prof Gumbo received the following awards and achievements: External Recognition Award (2019); NRF C1 Rating (2021); NRF C1 Rating Award (2021); Recognised among the Top 10 000 Influential Scientists in Africa in the AD Scientific Index (2021–2022); Competitive Programme for Rated Researchers (2022), Research Professorship (2022); Chancellor's Award for Excellence in Research (2022).

Plenary Title and Abstract:

A relook into Technology Education: Raising a transformational issue

South Africa and other African states, which are now "free" from colonial rule have the opportunity to transform their sectors such as education, mineral and energy, agriculture, tourism, etc. The focus of this presentation is on education, specifically the curriculum of Technology Education as school a subject. In South Africa, the transformation of education is a critical project that confronts the injustices of the pre 1994 regime. It is therefore at the core of the Curriculum and Assessment Policy Statement (CAPS), visible through the principles such as Indigenous Knowledge Systems (IKS), social justice, human rights, etc. However, not much has been done yet to realise transformation in the implementation of the CAPS in its IKS-flavoured fashion. This is a compromise of the decolonial, Africanisation, or even indigenisation of the curriculum, all of which are critical aspects of transformation. Therefore, in this presentation, I raise an issue of transformation as it pertains to the Technology Education curriculum. Employing Schumpeter's leapfrogging lens, I show how technology, which learners learn in Technology Education, is still hooked onto the colonial perspective. I show how this parallels the industrial revolution. I further show how colonialism still thrives, now sugar-coated in the globally entrenched technological practice which enjoys technological violence on indigenous people. Indigenous technology is leapfrogged by conventional technology which is commonly known as modern technology despite the beyond-doubt prevalence of the former which disputes it being alleged as primitive or outdated. I then suggest strategies to think indigenously about Technology Education and its implementation as such.

This discourse is important because learners are presented with one alternative to technology – a Western-dominated alternative, which should be revisited. This one alternative form of technology parades the Western technological practitioners as the only ones who know and master technology. To do justice to transformation, educational authorities down to teachers should be made aware of the Western notions of technology that still define the Technology Education curriculum, thus making it irrelevant to a great extent to indigenous learners as well as denying the non-indigenous learners the indigenous perspectives of technology. Teaching learners technology that is not attuned to their real cultural contexts adds to their difficulty in understanding the subject and their performance suffers ultimately. Learners are prepared to identify problems for urban environments which mainly portray Western establishments and design solutions that resemble such environments. This is to the disadvantage of rural environments which are mainly inhabited by indigenous people – their sustainable development is compromised. Teachers should be empowered to think about the subject in transformational terms and teach it as such, especially because it is reality-based and more practical than theoretical.

WELCOME MESSAGE FROM THE CONFERENCE CHAIR

Good morning, ladies and gentlemen. On behalf of the Local Organizing Committee (LOC), I am honored to welcome everyone to the 31st meeting of SAARMSTE Conference opening today Tuesday, 17 January 2023. We are pleased to receive the highly esteemed Mathematics, Science and Technology researchers and professionals from various countries and provinces in attendance and participating in this hybrid conference in the post Covid-19 pandemic era. We are excited to have delegates attend both in-person and virtually.

I am specially honored to welcome the Chief Host of the conference Professor Francis Petersen who has graced us with his presence. I am equally honored to welcome SAARMSTE President, Dr Tulsi Morar and the Executive Committee members and recognize their efforts in ensuring the achievement of the Association's important mandate of growing Mathematics, Science and Technology education research and practice; the Plenary Speakers at this Conference including Professor Susanne Prediger - Mathematics, Professor Gillian Roehrig - Science, and Professor Mishack Gumbo - Technology Education for generously accepting to share their wealth of research experiences and insights with the delegates of this conference. I am also pleased to especially welcome the Dean of Education at the University of the Free State, Professor Loyiso Jita, who has guided and supported the LOC as we prepared for this conference. I welcome all the participants in their different strands who will be presenting and discussing the many well-researched papers received and accepted for the Conference and all our sponsors. The SAARMSTE Choir led by Professor Melissa Rollnick, the Conference MC, Professor Mogege Mosimege, the sectional chairs and discussants in their diversity, who will lead the interesting discussions on research insights presented in this conference.

The 31st Conference of the Southern African Association for Research in Mathematics, Science and Technology Education is a hybrid Conference that runs from today, Tuesday 17– Thursday 19 January 2023. The Conference theme is "Intersecting Research, Policy, and Practice for a Sustainable Praxis in Mathematics, Science and Technology Education: possibilities and directions for the post-COVID-19 Pandemic Era," It is my expectation that the Conference shall help us see the research and practice directions in mathematics, science and technology education.

I acknowledge the LOC Secretaries – Mrs Elsa Bester, Mrs Christa Duvenhage, Ms Carike Swart and Prof Thuthukile Jita; the Fundraising chairperson – Dr Cobus Van Breda; Programme Co-Chairs – Dr Maria Tsakeni and Prof Mogege Mosimege; Logistics Committee – Dr Angela Stott and Dr Zukiswa Nhase for diligently making this conference a success. I also commend Ms Carolyn Stevenson-Milln of the SAARMSTE Secretariat for her efficiency and wisdom in guiding and helping the LOC to put together this great Conference.

Based on the conference paper themes, I want to assure all the delegates that we shall be engaging in very fruitful and exciting debates in the three days of this Conference. The paper themes include sub-themes such as STEM integration, IKS integration, Language, Technology integration, Professional development, Robotics education, PCK and curriculum implementation. On the first day, I invite you to the plenary speech by Prof Susanne Prediger from the German National Center for Mathematics Teacher Education who will be speaking on "Fostering students' understanding of procedures and underlying basic concepts: Design research for mathematics classrooms and teacher professional development in the post-pandemic era." On the second day, I invite you to the virtual plenary speech by Prof Mishack Gumbo from the University of South Africa who will be speaking

on “A Relook into Technology Education: Raising a transformational issue.” On the third day, I invite you to the plenary speech by Prof Gillian Roehrig from the University of Minnesota who will be speaking on “The Hows and Whys of Integrated STEM Education.” I request that you join us for the cocktails, “meet and greet” and visit to the planetarium at 18:00 today in the new and beautiful Science for the Future Centre building. On the second day, I request you to attend the SAARMSTE Annual General Meeting (AGM) Hybrid at 17:45 hours which will be followed by Choir Rehearsal. On the third day, we will have the Gala Dinner at 17:30 in the Centenary Hall. Finally, I request you to rate the entries in the “One Slide Competition” through the link provided in the conference programme.

I hope you will enjoy what we have on the programme in the 2023 SAARMSTE Conference.

Once again, you are all welcome!

Thank you.

Dr Maria Tsakeni

Conference Chair

GUIDELINES FOR PAPER SUBMISSION AND PRESENTATION

Long paper: Maximum of 6000 words, including references, for a pre-recorded, presentation. Long papers are equivalent to journal publications utilising the same criteria as AJRMSTE articles and are reviewed accordingly. In accepting a long paper for presentation at the SAARMSTE conference, the Review Panel presumes:

1) The paper is original and has not been published elsewhere;
2) Permission will be granted by the author for the accepted long paper to be published in the accredited *Book of Proceedings*;
3) At least one of the authors will register and attend the conference to present the paper;
4) First authors will only present one long paper at each conference.

Long papers are fully peer reviewed and thus attract Department of Higher Education and Training subsidy.

Short paper: Maximum of 1500 words, including references, for a pre-recorded presentation. Short papers should highlight preliminary findings and significance of the research. Short paper submissions could be the first draft of a journal article consisting of: abstract, introduction literature review, methodology, results and conclusions. Authors are encouraged to submit short papers for development of an article at the post conference workshop. After acceptance of the 1500-word short paper, authors may elect to develop their research further into a 3600-word paper which will NOT be reviewed but, after consultation with the editor, could appear in the electronic record of Research Papers in Mathematics, Science and Technology Education. Short papers are **not** eligible for DHET subsidy.

Snapshot paper: Maximum of 1500 words, including references, for a pre-recorded presentation. Snapshot papers should be based on emerging research, not necessarily with results, but with a framework of: abstract, introduction, literature review, methodology and the way forward.

Symposium / panel paper: Maximum of 1500 words, including references, for a 90-minute panel discussion around issues where different points of view, approaches, debates or analysis of the same problem are presented. The paper should contain details of each speaker's contribution and how these come together to create a forum for debate. This is not a forum for the presentation of multiple short papers. The emphasis is on exchange of ideas and discussion.

Short papers, snapshots, posters and symposia papers should appear in the 2021 electronic record of Research Papers in Mathematics, Science and Technology Education. These are not fully peer reviewed and thus do not attract Department of Higher Education and Training subsidy.

REVIEWING PROCESS – SAARMSTE LONG PAPERS 2023

All 6 000-word long paper submissions were reviewed by at least two external reviewers.

Reviewers were selected from the list of reviewers for the accredited African Journal for Research in Mathematics, Science and Technology Education (AJRMSTE) published by Taylor & Francis. Other recognised researchers in the field of Mathematics, Science and Technology Education were also approached to be reviewers.

The reviewers' decisions and developmental comments were considered by members of the Review Panel. Where there was consensus, the reviewers' recommendations were accepted by the Panel. Where consensus was not reached, the Review Panel appointed at least one other reviewer and all reviews were taken into consideration before a decision was made.

In cases where papers were accepted with conditions, authors were guided to make changes in order to have their papers accepted, or to provide a compelling argument for no further revision.

Long Papers that were re-worked and re-submitted by authors underwent a final review and edit process before being published in the accredited *Book of Proceedings*.

31ST SAARMSTE CONFERENCE 2023 –SUMMARY SLIDE COMPETITION

All delegates were invited to participate in a new SAARMSTE initiative in which they summarised their work in a single slide.

Visit https://bit.ly/SAARMSTE2023 or scan the QR code alongside to view and interact with the entries.

Star-rate entries (5 starts best), ask questions, make comments and give constructive feedback.

The winner will be announced in the closing ceremony.

31ST SAARMSTE CONFERENCE 2023 –PROGRAMME

Tuesday 17th January 2023 Time: 07h30 - 17h00 - DELEGATE REGISTRATION DESK. Venue: New Education Auditorium Time: 08h30 – 9h30 OFFICIAL OPENING: MC - Prof Mosimege. Welcome by Prof Loyiso Jita, Dean of the Faculty of Education and Address by Prof Francis Petersen Vice Chancellor of UFS. Leads into the start of the Conference Programme sessions by Dr Maria Tsakeni (LOC Chair).		
	Mathematics PAPERS **Venue: New Education Bdg. Room 12**	**Science PAPERS** **Venue: New Education Bdg. Room 13**
Theme: ***09h30 – 11.00***	***MATHEMATICS - Preservice Mathematics Education***	***STEM & language integration in science***
Discussants	*Bruce Brown, Karin Hackmack*	*Thuthukile Jita, Ester Shinana*
	Kevin Larkin & Peter Grootenboer Pandemics, PSTs, and Pedagogy: Future Proofing ITE Mathematics Education M2023_001_SP	**Nadaraj Govender** Preservice Science Teachers' engagement in Science via Agricultural Garden Projects: Implications of STEM praxis for Education for Sustainable Development Sc2023_001_SP
	Marisa Kumm, Mellony Graven & Lise Westaway Exploring Foundation Phase pre-service teachers' mathematical pedagogical content knowledge for teaching additive mental mathematics strategies M2023_003_SN	**Olalekan Taofeek Badmus & Loyiso C Jita** Does Further-Mathematics Ability Predict Student's Achievement in Physics? A Correlational Diagnosis Sc2023_002_SP
	Clement Ayarabila Ali, N S Adzifome & E Nsemani Female Trainee Teachers and Inequality in Mathematics M2023_007_SP	**Masato Kosaka & N Nakawa** Effectiveness of Kenya's Strengthening of Mathematics and Science in Secondary Education Project on students' attitudes and behaviours: A qualitative analysis from the long-term perspective Sc2023_024_SP
	Bruce Brown Mathematical Insight of Students in a Primary Preservice Education Programme M2023_056_SP	**Allyson Rogan-Klyve, Brent Hancock, Emilie Hancock & Mark Oursland** Development and analysis of a geographically distributed STEM teacher leader network Sc2023_032_SN
	Frank Kwarteng Nkrumah & Craig Pournara What do mathematics teacher educators in Ghana consider to be important for their work in pre-service mathematics teacher education? M2023_041_SP	**Koketso Pila & Lydia Mavuru** The Cognitive Academic Language Proficiency needs of English second language pre-service and in-service Natural Sciences teachers Sc2023_023_SP

	Jogymol Alex & TL Trow Entry level student teacher knowledge in school mathematics M2023_050_LP	**Nomthandazo Gumbo, Lydia Mavuru & Aviwe Sondlo** Performance differences of grade 8 Natural Sciences learners taught in home language and second language Sc2023_041_LP
11h00-11h30 Coffee / Tea BREAK: New Education Building Foyer		
Theme: ***11h30 - 13h00***	***MATHEMATICS - Language and Mathematics Education***	***SCIENCE - PCK and Science Curriculum implementation***
Discussants	*Hlamulo Mbhiza, Tony Essien*	*Kenneth Ngcoza, Elizabeth Mavhunga*
	Senamile Dlamini and Anthony Essien Practices teachers use to mediate the Sepedi mathematics register in multilingual classrooms M2023_028_LP	**Judicial Sebatana & Washington Dudu** Enhancing physical sciences teachers' pedagogical content knowledge: An exploration of problem-based learning in the teaching and learning of three states of matter Sc2023_029_LP
	Thobela Ndamase and M Seoloane Language use by teachers and learners observed using the Bala Wande materials M2023_017_SP	**Maphole Marake, Loyiso Jita & Maria Tsakeni** Understanding experienced physics teacher's enacted Pedagogical Content knowledge when teaching force concepts Sc2023_021_LP
	Matshidiso Moleko,Gilbert Pule & Nkosinathi Mpalami Meaningful Learning of Mathematical Concepts Through Multiple Means of Action and Expression M2023_031_LP	**Marissa Rollnick, Rene Toerien & Ernest Mazibe** The evolution of an out of field teacher's PCK while solving a two-body problem in mechanics Sc2023_055_SP
	Sthembile Magwaza & Anthony Essien An analysis of the affordances for learning probability in a commonly used grade 12 mathematical literacy textbook M2023_061_SP	**Bongani Prince Ndlovu & Elizabeth Mavhunga** Content Knowledge For Teaching Science Made Explicit: A Case With Organic Chemistry Sc2023_016_SP
	Sally-Ann Robertson & Mellony Graven Understanding the Slow 'Multilingual Turn' M2023_044_SP	**Langanani Rakhunwana, Christine Mundy & Elizabeth Mavhunga** Exploring lecturers' TSPCK in electrochemistry Sc2023_027_SN
13h00 – 14h00 LUNCH TIME: Winkie Direko Building (Rooms 144, 145 & 147)		

14h00 - 15h15	**14h00 MATHS SYMPOSIUM 1**	**14h00 SCIENCE SYMPOSIUM 1**	
Discussants	***Stephen Taylor***	***Million Chauraya***	
	Hamsa Venkat, Mellony Graven, Ingrid Sapire, Stephen Taylor Interrogating advantages, dangers, opportunities and challenges of intervention implementation models: South African mathematics project experiences as stimulus for discussion M2023_012_SYM	**Million Chauraya, S M Masuku, V L Matsebul, M Mofolo, M Mphunyane, D Luchembe, Z Ndemo, V Mpofu, J P Mukaro** Stem Education and the Teacher Education Curriculum: Some Findings from four SADC Countries Sc2023_051_SYM	
Time: 15h15 – 15h30 Coffee / Tea BREAK: New Education Building Foyer			
15h30 – 16h45	**PLENARY 1: New Education Auditorium** **Professor Dr Susanne Prediger, Director of German National Center for Mathematics Teacher Education, Germany** **Fostering students' understanding of procedures and underlying basic concepts: Design research for mathematics classrooms and teacher professional development in the post-pandemic era**		
Discussant	**Mogege Mosimege**		
Theme: **16h45 – 18h00**	**Mathematics PAPERS**	**Science PAPERS**	**ASSESSMENT IN MATHS & SCIENCE EDUCATION SYMPOSIUM**
	Technology and Mathematics Education	***SCIENCE - IKS in science***	*Eunice Nyamupangedengu* **Presenters: Lawan Abdulhamid, H Tshesane, Maria Kazeni, Porti Kavai, Caleb Mandikonza, J Makonye, M Stephen, E Ajayi, M Mbalane** Exploring Mathematics and Science teacher educator assessment practices in the shift from face-to-face to an e-learning management systems: A case study at a South African university M2023024Sym
Discussants	*Frikkie George, Mike Askew*	*Zukiswa Nhase, Shalini Dukhan*	
	Abongile Ngwabe & Marc Schäfer Exploring the potential of how *GeoGebra* software can be used as a visual mediator between preservice teachers' mathematical pedagogical content knowledge and teaching proficiency M2023_037_SP	**Christine Mundy & B Nokeri** Students' perceptions of a "Bootlegging of alcohol" practical in the context of the Covid-19 prohibition and indigenous knowledge Sc2023_012_SP	

	Janine Bouwer, E D Spangenberg & V Ramdhany The use of GeoGebra by mathematics pre-service teachers in their learning to teach functions M2023_022_PO	**Nimrod Paseka Raphothe, Shalini Dukhan & Ida Risenga** Natural Sciences Teachers' Views on Indigenous Knowledge and How to Use it in Teaching and Learning in South African Classroom Sc2023_049_SP	
	Frikkie George, Marc Jacobs & Daniel Angaama Using an Online Social Media Platform to Assist Peer Learning and Students' Understanding of Engineering Mathematics Concepts M2023_034_SP	**Xolani Mayana, Kenneth Ngcoza & Joyce Sewry** Enriching learning of waves and sound through mobilizing indigenous practices and knowledge about the sea Sc2023_033_SP	
	Tammy Booysen, Lise Westaway & Mellony Graven The Nature of Visual Representation of Multiplication and Division Across Foundation Phase Textbooks M2023_039_LP	**Nompendulo Khoza, Shalini Dukhan, P Ramalepe & Ida Risenga** Imparting the IK on medicinal plants from traditional healers into the high school curriculum to enable learners to make meaning of Science Sc2023_036_SP	
	Lise Westaway, Pamela Vale & Samu Chikiwa An Analysis of the Early Number Sense Opportunities in the Grades R Curriculum and National Workbooks M2023_047_LP	**Lindiwe Priscilla Godlo, Kenneth Ngcoza & Chrispen Mutanho** Crossing the river: Different learner- perspectives on the integration of indigenous knowledge in science Sc2023_053_SP	
		Tarisai Mudzatsi Integrating community' cultural heritage in the teaching of the grade 10 physical sciences topic 'classification of matter' in Gauteng province, South Africa. Sc2023_056_SN	
18h00	**WELCOME: Cocktails: Hybrid 'meet and greet'. Visit to Planetarium - Dr van Breda** **Venue: Follow the signage next to Winkie Direko Building**		

Wednesday 18th January 2023			
Time: 08h30 – 10h00			
	Mathematics PAPERS Venue: New Education Bdg. Room 12	**Science PAPERS Venue: New Education Bdg. Room 13**	**Technology, Science & Other Matters of Interest Venue: New Education Bdg. Room 15**
Theme: 08h30 - 10h00	***Problem Solving in Mathematics***	***IKS in science***	***CASIO (08h30 - 09h15)***
Discussants	*Jogymol Alex, Clemence Chikiwa*	*Ernest Mazibe, Lydia Mavuru*	*Presented by: Astrid Schrieber*
	Karin Hackmack & Lise Westaway An analysis of multiplication and division word problems in three grade 4 South African textbooks M2023_010_SP	**Keith Khombomoni Chuma. Shalini Dukhan & Ida Risenga** Inclusion of South Africa's Indigenous Knowledge Bioprospecting aspects into the secondary school curriculum: The Case of Lippia javanica Sc2023_054_SP	CASIO Upgraded Technology in the Classroom
	Bafana Mavundla & Mogege Mosimege Analysis of Errors made by Grade 10 Learners in Simplifying Algebraic Expressions M2023_045_SP	**Uchechi A Ahanonye, Shalini Dukhan, Ida Risenga & R Otulaja** Science teachers' awareness of the inclusion of IK in the South African educational policy. Sc2923_057_SN	***JMTE (09h15 - 10h00)*** *Karin Brodie presents:*
	Ratham Hlupeni & Clemence Chikiwa A Probe into the Geometric Skills of a Selected Grade 11 Mathematics Class: A Case Study M2023_046_SP	**Sipho Nuntsu, Kenneth Ngcoza & Zukiswa Nhase** Mobilizing stories about cultural beliefs and practices on traditional foods to contextualize the topic nutrition in a grade 6 township class Sc2023_060_PO	Journal of Mathematics Teacher Education (JMTE)
	Angel Mukuka Students' Reflections on Learning Transformation Geometry in a Cooperative Learning Environment M2023_008_SP	**Lindiso Funani, Kenneth Ngcoza & Chrispen Mutanho** Centering learners in the science curriculum: Learners' dispositions and views on the integration of IK in the topic electrostatics. Sc2023_083_SP	
	Shaheeda Jaffer A window into grade 10 learners' geometric thought M2023_058_LP	**Nomvume Tyeda,Kenneth Ngcoza & Chispen Mutanho** Climbing a mountain: Learners' attitude and views on the integration of IK in the topic food processing Sc2023_084_SP	

10h00-10h30 Coffee / Tea BREAK: New Education Building Foyer			
Theme: 10h30 - 12h00	***Classroom Practices of Mathematics Teachers***	***PCK and Professional Development in science***	***TPCK and Robotics***
Discussants	*Mogege Mosimege, Hamsa Venkat*	*Flavia Kigozi, Christine Mundy*	*Zaynab Mobara-Links, Taryn Lovemore*
	Nomzamo Jack & Kenneth Ngcoza An exploration of the enablers and/or constraints when Grade 3 Foundation Phase mathematics teachers enact differentiated instructional practices in their township classroom M2023_036_SP	**Muthandwa Chinamhora Sincuba, Jogymol Alex & Sakyiwaa Boateng** Developing Physical Sciences Teachers Pedagogical Content Knowledge in the Integration of Educational Technologies in Teaching Physical Sciences in Mthatha Schools Sc2023_025_SN	**Adedayo Theodorio, Clement Simuja, T.W. Makata & Brian Shambare** Investigating teacher educators' strategies for integrating technology and using technological pedagogical content knowledge in teaching T2023_001_LP
	Hlamulo Mbhiza Mathematical accuracy of the teacher's explanations during functions lessons in a rural classroom M2023_048_LP	**Tasara Manamike & Kenneth Ngcoza** The Development of Teachers' PCK In The Mediation of Chemical Equilibrium: A Formative Interventionist Study Sc2023_026_SP	**Edgar J. Sintema & Thuthukile Jita** Fostering Classroom use of ICT among Pre-Service Science Teachers T2023_003_LP
	Permie Isaac & Ingrid Sapire Teachers' engagement with students when using the Bala Wande materials M2023_016_SP	**Judicial Sebatana & Washington Dudu** Natural Sciences teachers' Pedagogical Content Knowledge: A professional development intervention on Astronomical Concepts Sc2023_030_SP	**Paballo C Mokhatla & Leila Goosen** Policy and Practice for Sustainable Praxis in information and Communication Technologies Education: a Case Study on Rural Challenges T2023_012_LP
	Lisnet Mwadzangati Malawian Secondary Mathematics Teachers' Uptake Of Explanatory Communication During Lesson Study M2023_026_SP	**Thumah Mapulanga, Yaw Ameyaw & Gilbert Nshogoza** A Comparison Between Secondary School Teachers' and Students' Perceptions of Enacted Pedagogical Content Knowledge in Biology Sc2023_037_SP	**Mokiti Janefeke, Lereko Mohafa, Macheli Mofolo & Sechaba Koma** Challenges and Opportunities in Offering Robotics to Secondary Learners in Lesotho: A case Study T2023_002_SP
	Roger Metelerkamp & Robert Kraft Video clips as an additional facilitator for lesson study reflections by in-service teachers M2023_029_SP	**Eunice Nyamupangedengu & Eyitayo Julius Ajayi** Exploring Life Sciences pre-service teachers' Pedagogical Reasoning behind the choice of videos they used during a microteaching activity: A Case Study at a South African university Sc2023_086_SP	**Tafirenyika Mafugu & K Mosia** The state of readiness for implementing coding and robotics in high schools in one district T2023_005_SP
	Msebenzi Rabaza & Joleen Hamilton Interpretation of mathematics teachers' explanations about learners' misconceptions of misunderstanding zero when working with decimal numbers M2023_030_SP		

12h00 - 13h15	**Plenary 2: New Education Auditorium** **Professor Mishack T Gumbo, Research Professor of Indigenous Technology Knowledge Systems Education in the Department of Science and Technology Education at the University of South Africa.**		
	A relook into Technology Education: Raising a transformational issue		
Discussant	**Maria Tsakeni**		
13h15 – 14h15 LUNCH TIME: Winkie Direko Building (Rooms 144, 145 & 147)			
14h15 – 15h45	***14h15 MATHS SYMPOSIUM 2***	***14h15 SCIENCE SYMPOSIUM 2***	***14h15 MEETING***
Discussants	*Hamsa Venkat & Mellony Graven*	*Kenneth M Ngcoza*	*Susanne Prediger presents:*
	Presenter: Corin Mathews, Samantha Morrison, Herman Tshesane, Antony Essien, Kathleen Fonseca, Emmanuel Libusha, Hayley van der Haar, Jeanette Ramollo, Lise Westaway, Samu Chikiwa, Marisa Kumm, Tarryn Lovemore, Rose Brien, Byron Abrahams, Msebenzi Rabaza & Joleen Hamilton. Incorporating attention to Mental Mathematics in pre-service teacher education: The Mental Mathematics: Work-integrated learning project **Respondent: Michelle Mathey** M2023_014_SYM	**K. M. Ngcoza, Z. Nhase, C. Mutanho, E. Shinana, P. Cimi, S. Nuntsu, and M. Nyamakuti** The power of indigenous African women in fostering cultural brokerage practices to decolonise the science curriculum in Sub-Saharan Africa Sc2023_072_SYM	Meet the Editor of Educational Studies in Mathematics; Become a Reviewer
	15h45-16h15 Coffee / Tea BREAK: New Education Building Foyer		
	MATHEMATICS PAPERS	**SCIENCE PAPERS**	**TECHNOLOGY PAPERS**
Theme: 16h15 - 17h45	***Mathematical Identities***	***Science curriculum implementation***	***PD and technology curriculum implementation***
Discussants	*Kevin Larkin, Anthony Essien*	*Alfred Mapfumo, Million Chauraya*	*Nixon PJ Teis, Leila Goosen*
	Aarifah Gardee & Karin Brodie The mathematical identities of successful learners M2023_002_LP	**Busiswa Mzilikazi** Understanding how to teach climate change in the senior phase by in-service natural science teachers Sc2023_082_SP	**Bolanle Olaniyan & Nadaraj Govender** Sustainable land management: Lessons from Nigerian root and tuber farmers T2023_007_SP

	Wellington Hokonya Understanding mathematical identities of mathematical literacy learners who participated in after-school mathematics clubs in primary school M2023_009_SP	**Alfred Mapfumo & Kenneth Ngcoza** Exploring relevant prior content knowledge that grade 12 Physical Sciences learners have before learning the work-energy theorem Sc2023_080_SP	**Bolanle Olaniyan & Nadaraj Govender** The role of indigenous knowledge methodology in negotiating research with farmers and stakeholders regarding climate change T2023_008_SP
	Cathrine Kazunga & Sarah Bansilal Using Rasch analysis to improve the functioning of an assessment instrument in Linear Algebra M2023_062_SP	**Tasara Manamike & Kenneth Ngcoza** Exploring the teaching of chemical equilibrium in Namibia: A focus on the challenges and some mitigation strategies Sc2023_010_SP	**Zaynab Mobara-Links & Nixon Teis** Assessment For Learning: A Technology Education Context T2023_010_SP
	Roxanne Long & Mellony Graven Grade R Teacher Changing Expressions of Themselves as Teachers of Numeracy M2023_032_SP	**Halalisani Mngomezulu, S Ramaila & T Dhurumraj** Teachers' experiences of the enactment of formative assessment in Physical Sciences teaching and learning Sc2023_007_LP	
	Tarryn Lovemore, Sally-Ann Roberston & Mellony Graven Integrating mathematics and music to support fractional reasoning across multiple constructs: A task design journey M2023_043_LP	**Hlengiwe Tshitshi, Kenneth Ngcoza & Chrispen Mutanho** Farm school learners' voices count: Learners attitudes and views on the integration of IK in the topic - Sound and Movement Sc2023_079_SP	
	Kesdisaletse Stella Mutlane A Collaborative Intervention that Seeks to Develop Grade One Mathematics Teachers' Pedagogical Content Knowledge M2023_049_SP		
Time: 17h45 – 18h45			
SAARMSTE Annual General Meeting (AGM) Hybrid - followed by Choir Rehearsal **Venue: New Education Building Auditorium**			

Thursday 19th January 2023			
Time: 08h30 – 10h00			
	Mathematics PAPERS Venue: New Education Bdg. Room 12	**Science PAPERS Venue: New Education Bdg. Room 13**	**Technology, Science & Other Matters of Interest Venue: New Education Bdg. Room 15**
Theme: 08h30 - 10h00	***Mathematics Curriculum Design and Implementation***	***Science laboratory/practical work***	***Preservice science teacher preparation***
Discussants	*Mellony Graven, Joleen Hamilton*	*Olalekan Taofeek Badmus, Marissa Rollnick*	*David Letloenyane, Makomosela Qhobela*
	Satoshi Kusaka Analysis on Endogenous Mathematics Curriculum Development and Revision in Mozambique: The Case of the 2021 Curriculum Revision M2023_005_SN	**Sibusiso Masuku & Celumusa Ntshangase** Reflecting on Own Practice Through a Teacher-Developed Secondary School Science Test in Eswatini Sc2023_003_SP	**Makomosela Qhobela** Physical Science Preservice Teachers' experiences of using English as a medium of instruction during Teaching Practice Sc2023_038_SP
	Fraser Gobede Analysis of an early grade mathematics teacher's dilemmas when handling multi-digit addition M2023_059_LP	**Angela Stott & Annemarie Hattingh** The efficacy of use of a heuristic for guiding preservice natural sciences teachers' planning of an experimental investigation Sc2023_009_SP	**Maisaiah Phakisi** Investigating the alignment in competencies development in teacher training and primary school science curriculum Sc2023_043_SN
	Gerrit Cloete & Msebenzi Rabaza Using number talks collaborative teaching and learning strategy to improve teacher assistants' performance in number sense M2023_013_SP	**Enid Oguoma & Thuthukile Jita** Teachers' levels of use of practical work in the Physical sciences curriculum Sc2023_035_LP	**Hlologelo Climant Khoza & B Maseko** Collaborative concept mapping: Investigating the nature of discourses and features of a concept map Sc2023_062_SN
	Matome Edwin Matsepe Modes of Reasoning Presented in Two 9th-Grade Mathematics Textbook Explanations on the Topic of Linear Graphs in South Africa M2023_051_SP	**Francinah Futhane & Rethabile Tekane** Chemical Safety and Security Education: Laboratory Personnel's Views Sc2023_061_SN	**Joe P. Mukaro, Eunice Nyamupangedengu & Jane Kaifa** Investigating the impact of a rubric guided workshop on the content knowledge for cell cycle and biodiversity topics among in-service graduate biology teachers: A case study Sc2023_064_LP
	Justina Longwe-Mandala Mathematics teacher educators' selection of examples in pre-service teacher education classroom M2023_054_LP	**Mabel J. Mabalane** Examining the technical sciences content in line with bloom's revised taxonomy of educational objectives Sc2023_081_SP	**Naomi Thomas & Eunice Nyamupangedengu** An exploration of how opportunities for learning are created in biology teacher education classrooms: A case of four teacher educators Sc2023_067_SP

			David Letloenyane Exploring opportunities to learn as experienced curriculum: Affordances in selected science teacher education programmes in South Africa Sc2023_070_SP
10h00 - 10h30 Coffee / Tea BREAK: New Education Building Foyer			
Theme: **10h30 - 12h00**	***Mathematics Classroom Environments***	***NOS and Science Process skills***	***Conceptual understanding in science classrooms***
Discussants	*Shaheeda Jaffer, Lise Westaway*	*Chrispen Mutanho, Meshach Ogunniyi*	*Devasmita Chakraverty, Maphole Marake*
	Tabisa Booi Research-informed development of isixhosa teaching and learning materials for doubling and halving in grade 3 M2023_063_PO	**Renee Schwartz, Robert Bennette & Emily Little** Relationships Among Science Experiences, Science Identities, And Nature Of Science: Perceptions Of Novice Science Teachers Sc2023_031_SP	**Rosemary Naana Kumi-Manu & Sakyiwaa Boateng** Assessing Pre-Service Science Teachers' Academic Knowledge and Misconceptions about Evolution and Genetics Sc2023_077_SN
	Thulelah Takane Exploring Mathematizing processes of South African learners for solving additive relation situations M2023_015_SP	**Flavia Kigozi, Shalini Dukhan & Ida Risenga** The Development of Science Identity among Science Undergraduates at a South African University Sc2023_058_SN	**Ademola Olaniyan Nadaraj Govender** An investigation of High School Students Conceptual understanding of Geometric Optics Sc2023_068_SP
	Vuyokazi Mafilika & Lorna Sako Moving away from counting as an operation strategy: preliminary evidence from the Bala Wande programme M2023_018_SP	**Mamohato Makhechane, Makomosela Qhobela & Lereko Mohafa** Investigating PSTs' views about how their chosen representations can effectively develop scientific concepts: A case of two physics pre-service teachers Sc2023_071_SP	**Kevalan Moodley, Doras Sibanda & Mary-Ann Good** Exploring students conceptual errors regarding atomic structure in grade 10 physical science Sc2023_008_SP
	Lovejoy Gweshe and Karin Brodie Learners' Productive Dispositions: The Case Of An After-School Mathematics Club M2023_020_SP		**Thamsanqa Sihele & Sakyiwaa Boateng** The "Unheard Voices": Examining Factors that Contribute to the Poor Performance of Grade 12 Life Science Learners in Rural Schools in the Eastern Cape Region Sc2023_014_LP
			Letisha Lalbahadur, Shalini Dukhan & Kershree Padayachee An exploration of first-year medical students' cell biology prior knowledge and its effect on subsequent conceptual understanding Sc2023_042_SP

12h00 – 13h15	**Plenary 3 Venue: New Education Auditorium** **Dr / Professor Gillian Roehrig, Professor of STEM Education at the University of Minnesota.** **The Hows and Whys of Integrated STEM Education**		
Discussant	**Dr Cobus Van Breda**		
13h15 - 14h15 – LUNCH TIME: Winkie Direko Building (Roms 144, 145 & 147)			
Theme: 14h15 - 15h45	***Mathematical Content Knowledge***	***Decolonising the science curriculum***	***Professional development and science curriculum implementation***
Discussants	*Matshidiso Moleko, Sally-Ann Robertson*	*Washington Dudu, Judicial Sebatana*	*Eunice Nyamupangedengu, Martin Braund*
	Nkazimulo Zitha & Anthony Essien An analysis of fraction word problems in intermediate phase learner book M2023_060_SP	**Thuli Gladys Ntuli & Awelani V Mudau** Developing isiNdebele scientific language register for natural sciences and its classroom application in some classes in the Siyabuswa 2 circuit, South Africa. Sc2023_004-SN	**Tholani Tshuma & Eunice Nyamupangedengu** The opportunities and challenges of using a self-study approach as a strategy for professional development: the case of evolutionary genetics teaching Sc2023_063_SP
	Nozuko Nqabeni, M Buka & V Momoti Implementation of virtual teaching fraction algorithms for educational productivity to foundation phase learners in or tambo inland district primary schools M2023_053_SN	**Angelius K Liveve, Kenneth Ngcoza & Zukiswa Nhase** Exploring the use of Grade 10 Physics teachers' professional Learning Community and Community Experts in bridging the learners' life-world culture and school science culture Sc2023_046_LP	**Sechaba Koma & Malefu C Nthathakane** Understanding How Secondary Schools Implement Grade 8 Science and Technology Integrated Curriculum Sc2023_048_SP
	Nontsikelelo Luxomo Explanations of constitutive elements of algebra: variable, constant and a coefficient. M2023_057_SP	**Chrispen Mutanho & Kenneth Ngcoza** Supporting teachers to integrate diverse indigenous knowledges in multicultural classrooms SP-Sc2023_078_SP	**Tisetso Mosala, K C Mathabathe & Rethabile Tekane** Exploring students' perceptions and opportunities for curriculum reform in an academic development programme chemistry module Sc2023_052_SN
		Meshach Ogunniyi & D Angaama Worldviews held among pre-service science teachers in five non-western countries Sc2023_085_LP	**Devasmita Chakraverty** Impostor phenomenon among biology education researchers: An exploratory study Sc2023_006_SP
		Martha N Nyamakuti, Kenneth Ngcoza & Zukiswa Nhase Bringing community back into Namibian Education system T2023_006_SP	

15h45 - 16h15 Coffee / Tea BREAK: New Education Building Foyer			
Theme: 16h15 - 17h45	***Combination of Study Groups in Mathematics Education***	***PCK and curriculum implementation in science***	***Use of ICTs in science classrooms***
Discussants	*Msebenzi Rabaza, Herman Tshesane*	*Mamohato Makhechane, Renee Schwartz*	*Angela Stott, Tafirenyika Mafugu*
	Herman Tshesane, Hamsa Venkat & Mike Askew Blending Realistic Mathematics Education and Relational Paradigms for Contextual Proximity in South Africa M2023_021_SP	**Olutosin Solomon Akinyemi, M Mavhunga & Faith Zondi** Preliminary findings emerging from developing a rubric for measuring Digital TSPCK in teaching videos Sc2023_047_SP	**Rethabile Tekane** The use of Chirality-2 app in a first-year organic chemistry class: students' perceptions of using the app for learning. Sc2023_075_SN
	Tracey Butchart & Karin Brodie The Extent and Distribution of Mathematics Learning Backlogs Among South African High School Learners M2023_025_LP	**Ernest Mazibe & Marissa Rollnick** Examining the presentation of electrostatics in selected textbooks using the pedagogical content knowledge construct Sc2023_059_SP	**Shalini Dukhan** A hybrid initiative to determine how a lecturer of a large, first-year biology class could engage tutors to efficiently gain insight into students' understanding of course material and academic challenges Sc2023_028_SP
	Sifiso Vilakazi & Sarah Bansilal An APOS analysis on how Grade 10 learners engage with factorisation of quadratic expressions M2023_035_LP	**Nthatisi Puputla & Makomosela Qhobela** Exploring biology teachers' subject matter knowledge in genetic engineering; A case of three high school teachers Sc2023_069_SP	**Lereko Mohafa, Mamohato Makhechane & Makomosela Qhobela** Establishing how blended learning influenced physical science pre-service teachers' self-efficacy and motivation Sc2023_020_SP
	Naomi Kgothego & Lise Westaway The Use of Lesson Study in Developing Grade 1 Teachers' Pedagogical Content Knowledge M2023_038_SP	**Ester Shinana, Kenneth Ngcoza, Clement Simuja & Elizabeth Mavhunga** Exploring the effect of an intervention on Namibian Biology teachers' procedural knowledge of the scientific inquiry Sc2023_074_SN	**Martin Braund** What does the COVID pandemic mean for teaching in Life Sciences? Sc2023_005_SP
	Shikha Takker, Craig Pournara & Iresha Ratnayake Design research short teaching interventions and numeric equations: What promise do they hold for improving teaching and learning of equations? M2023_040_SP	**Mpumelelo Faith Zondi & Elizabeth Mavhunga** How to teach Digital-TSPCK? A case study with chemistry pre-service teachers Sc2023_040_SP	**Macheli Mofolo, Sechaba Koma & Sikeme Raphoka** Physical Science Teachers' Experiences with Accelerated Teaching and Learning Post COVID-19 Disruptions Sc2023_018_SP
		Biyela Ntshangase & Jeanne Kriek Influence of an adapted lesson study approach on lesson development of photoelectric effect Sc2023_022_SP	

17h45 - 18h15	**CLOSING CEREMONY & Conference 2024 Presentation** **Venue: New Education Building Auditorium**
GALA DINNER EVENT: Awards; President handover; Choral Recital and Celebration (Hybrid) Venue: Centenary Hall **18h30**	

SAARMSTE 2023 ABSTRACTS

MATHEMATICS SYMPOSIA

M2023_012_SYM

INTERROGATING ADVANTAGES, DANGERS, OPPORTUNITIES AND CHALLENGES OF INTERVENTION IMPLEMENTATION MODELS: SOUTH AFRICAN MATHEMATICS PROJECT EXPERIENCES AS STIMULUS FOR DISCUSSION

Co-ordinators (and corresponding authors):

Mellony Graven & Hamsa Venkat

Presenters:

Hamsa Venkat: Dublin City University and University of the Witwatersrand
Mellony Graven: South African Numeracy Chair, Rhodes University
Ingrid Sapire: University of the Witwatersrand
Stephen Taylor: Department of Basic Education
M Rabaza & J Hamilton: University of the Free State

In this symposium we hope to stimulate discussion and debate around the advantages and disadvantages of a spectrum of two quite different approaches to large scale interventions in mathematics education recently emerging in the South African landscape. These we refer to as the 'building your timber' (BYT) and 'straight to scale' (STS) models. A measured 'unhurried' model of building to national-level implementation is described as a 'building your timber' approach, because of its attention to developing the capacity for scalability while scaling up. On the other hand, advantages of designing straight to scale interventions is that implementation timelines can be much tighter and more reactive to specific needs of the times.

M2023_014_SYM

INCORPORATING ATTENTION TO MENTAL MATHEMATICS IN PRE-SERVICE TEACHER EDUCATION: THE MENTAL MATHEMATICS WORK-INTEGRATED LEARNING PROJECT

Hamsa Venkat and Mellony Graven

Corin Mathews, Samantha Morrison, Herman Tshesane, Antony Essien: University of the Witwatersrand; Kathleen Fonseca, Emmanuel Libusha, Hayley van der Haar: University of Johannesburg; Jeanette Ramollo: Tswane University of Technology; Lise Westaway, Samu Chikiwa: Rhodes University; Joleen Hamilton, Msebenzi Rabaza: University of the Free State; Marisa Kumm, Tarryn Lovemore: Rhodes and Varsity College; Rose Brien, Byron Abrahams: Cape Peninsula University of Technology; Michelle Mathey: Department of Higher Education and Training

In this symposium, presenters from different higher education institutions share the varied approaches they have taken to research and development linked to mental mathematics in their primary pre-service teacher education offerings. This work has occurred in the context of supporting mental mathematics development on the ground that has been carried out in the Mental Starters Assessment Project (MSAP) led by the two SA Numeracy Chair teams in collaboration with the DBE. With the MSAP materials and model now being part of national policy rollout in Grade 3, a natural next stage is to ensure that pre-service primary teachers are well prepared to work with these materials and with mental mathematics more broadly in their teaching.

Michelle Mathey from the DHET offers a response to the approaches taken across the different institutions, with time for discussion of differences in the higher education terrain that feed into the varied approaches being taken.

M2023_024_SYM

EXPLORING MATHEMATICS AND SCIENCE TEACHER EDUCATOR ASSESSMENT PRACTICES IN THE SHIFT FROM FACE-TO-FACE TO AN E-LEARNING MANAGEMENT SYSTEMS: A CASE STUDY AT A SOUTH AFRICAN UNIVERSITY

E. Nyamupangedengu, L. Abdulhamid, H. Tshesane, M. Kazeni, P. Kavai, C. Mandikonza, J. Makonye, M. Stephen, E. Ajayi, M. Mabalane
University of the Witwatersrand

The lockdowns precipitated by the COVID-19 pandemic necessitated a shift from face-to-face/invigilated assessments to assessment on an e-learning management system (e-LMS). In this symposium, we will share experiences, challenges, opportunities and success stories, on the shifts of assessment practices of a group of Maths and Science teacher educators at a South African university. The group is a professional learning community (PLC), which consists of 10 teacher educators, that uses the concept of authentic conversations, as a means for learning and for supporting learning, within a community of practice. One collective observation on the shift to e-LMS assessment relates to the fact that, students are now, to a greater extent controlling their assessment environment. As a result, assessments have effectively become open-book examinations. The question remains to what extent (if at all) is this compromising the integrity of our assessments? Discussion of this question by the PLC is ongoing and insights will be shared at the symposium as an invitation to conference attendees to join the conversation by sharing their own experiences of online assessments.

SCIENCE SYMPOSIA

Sc2023_051_SYM

STEM EDUCATION AND THE TEACHER EDUCATION CURRICULUM: SOME FINDINGS FROM FOUR SADC COUNTRIES

M. Chauraya[1], M. Mphunyane[2], M. Mofolo[3], S. M. Masuku[4], V. L. Matsebula[5], D. Luchembe[6], V. Mpofu[7], J. P. Mukaro[8], Z. Ndemo[9]

Midlands State University[1]; National University of Lesotho[2]; Lesotho College of Education[3]; Examinations Council of Eswatini[4]; William Pitcher College Eswatini[5]; Mukuba University[6]; Bindura University of Science Education[7]; University of Zimbabwe[8]; Bindura University of Science Education[9]

STEM Education is viewed as central to the curricula of education systems internationally. Mainstreaming STEM Education is seen as one way of capacitating future professionals who will be drivers in scientific and technological innovations, which in turn can result in industrial and economic development. In any country successful realisation of STEM Education goals is dependent on how this form of education is conceptualised and implemented. The Symposium interrogates how STEM Education is understood and implemented in the teacher education curricula of four SADC countries. Panelists will outline the STEM Education policy frameworks in their country, the goals of STEM Education, and present findings of their analyses of some teacher education programmes

for elements of STEM Education. Affordances and constraints of mainstreaming STEM Education in the teacher education curricula will be highlighted.

Sc2023_072_SYM

THE POWER OF INDIGENOUS AFRICAN WOMEN IN FOSTERING CULTURAL BROKERAGE PRACTICES TO DECOLONISE THE SCIENCE CURRICULUM IN SUB-SAHARAN AFRICA

Kenneth M. Ngcoza[1], Zukiswa Nhase[2], Chrispen Mutanho [1], Phumlani Cimi[1], Ester Shinana, [1]Siphu Nuntsu[1], Martha Nyamakuti[1]
[1]Rhodes University, [2]University of Free State

The integration of indigenous knowledge (IK) in science teaching seems to be embraced and encouraged in sub-Saharan Africa. The belief is that this has the potential to contextualise science making it relevant and accessible to learners and revitalise the curriculum as reiterated by scholars such as Cocks et al. (2012) and Smith (1999). Despite these ideals, however, the rhetoric is that science curricula seem to be silent about how teachers should put theory into practice. As a result, teachers seem to be grappling to enact the new curriculum and therefore their learners continue to find science alienating and experience cognitive dissonance (Le Grange, 2007). It is against this backdrop that in our MEd and PhD programmes we resorted to forming a community of practice (Lave & Wenger, 1991; Wenger, 1998) to explore ways and strategies on how to research possibilities on how to integrate IK into the science curriculum using bottom-up decolonisation (Seehawer, 2018a).

MATHEMATICS LONG PAPERS

M2023_050_LP

ENTRY LEVEL STUDENT TEACHER KNOWLEDGE IN SCHOOL MATHEMATICS

Jogymol Alex & Terri Trow
Walter Sisulu University

Mathematics teachers' subject-specific knowledge plays a key role in determining the quality of mathematics instruction in secondary schools. This paper reports on the knowledge in secondary school mathematics of entry level student teachers in a rural higher education institution. The sample consisted of 134 entry level mathematics education students of a Bachelor of Education Senior Phase and Further Education and Training Teaching Programme registered for the year 2022, who voluntarily took part in the study. Entry level student teachers were subjected to writing online Computer Aided Mathematics Instruction (CAMI) baseline tests for Grades 7-12 at the onset of the mathematics education course. The analysis of the curriculum documents and the performance of the student teachers on the different content areas constituted the data for the quantitative study. Theories on mathematical knowledge and curriculum knowledge framework provided the lens for the analysis of the performance in the test. The low performance of the student teachers' points fingers to the mathematical knowledge that the student teachers enter the programme with. The study recommends that initial teacher education programmes should be implemented more effectively with rich opportunities and experiences on school mathematics. This in turn can address the deficiencies in secondary school mathematics instruction in South Africa.

M2023_039_LP

THE NATURE OF VISUAL REPRESENTATION OF MULTIPLICATION AND DIVISION ACROSS FOUNDATION PHASE TEXTBOOKS

Tammy Booysen
Rhodes University

Textbooks are an important tool for teachers and learners as they assist in identifying and sequencing content. In this paper, we report on the nature of visual representations in Foundation Phase textbooks and the Curriculum and Assessment Policy Statement for Mathematics. We draw on the Visual Representation Framework by Fotakoupoulou and Spiliotopoulou (2008) to analyse the type, function, relation to content and dimensions of each of the visual representations. The findings emergent from the research indicate that the most dominant type of visual representations are images that have a strong relation to content and reality. Most visual representations have an exemplifying function. An implication of this study is the importance of quality textbooks with a variety of valuable visual representations that are aligned to the Curriculum and Assessment Policy Statement.

M2023_025_LP

THE EXTENT AND DISTRIBUTION OF MATHEMATICS LEARNING BACKLOGS AMONG SOUTH AFRICAN HIGH SCHOOL LEARNERS

Tracey Butchart[1] & Karin Brodie[2]
School of Education, University of the Witwatersrand, South Africa.

This paper reports on learning backlogs in mathematics among a nationally representative sample of 2 522 South African high school learners. The learners' 'actual grades', i.e. their enrolled grades, were from Grades 8-12. The learners' 'effective grades', i.e. their average overall grade levels of mathematical functioning, were measured using a standardised diagnostic tool. Quantitative data was analysed and compared, giving two key findings. First, Grade 8 and 9 high school learners are on average four years behind the grade they are in and this gap widens in the last three years of schooling such that Grade 10 and 11 learners are on average five years behind, and Grade 12 learners are six years behind. Second, Grade 6 level seems to be a functional ceiling of proficiency that 80% of high school learners are unable to progress beyond before the end of high school.

M2023_002_LP

THE MATHEMATICAL IDENTITIES OF SUCCESSFUL LEARNERS

Aarifah Gardee and Karin Brodie
University of the Witwatersrand

The construction of mathematical identities by successful secondary school learners is a complex process, especially in contexts where learners experience traditional teacher-dominated pedagogies. In this paper, we explore the mathematical identities of two successful Grade 10 learners, who experienced traditional pedagogies in a South African school. Using a critical realist framework, mathematical identity is defined as a social phenomenon, which emerges from personal identity, social identity and agency. Findings show that for the learners' personal identities, both learners were invested in learning mathematics because mathematics brought them happiness, invoked their curiosity, was meaningful to them and important for their futures. For their social identities, both learners were invested in inspiring other learners in their classrooms to learn mathematics. Both

learners' personal and social identities were related to their agency, as they persevered to learn mathematics, even when encountering various challenges, some of which emerged through interactions with teachers and peers.

M2023_059_LP

ANALYSIS OF AN EARLY GRADE MATHEMATICS TEACHER'S DILEMMAS WHEN HANDLING MULTI-DIGIT ADDITION

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University of Malawi, Malawi

This paper advances the argument that dilemmas are central to the work of teaching early-grade mathematics. In this study, several dilemmas arising during lesson enactment are discussed using a qualitative case study of a Grade 4 teacher in Malawi who was working with multi-digit addition using the place-value algorithm. The aspects of mediation during the observed lessons were captured using the Mediating Primary Mathematics Framework. The teacher had to work with several dilemmas related to her selection of mediating tasks and examples, artefacts, chalkboard inscriptions, as well as her talk and gesture. The findings suggest that a detailed discussion of the dilemmas that teachers face in an early grade mathematics classroom can give insights into the nature of support that they need through professional development initiatives.

M2023_58_LP

A WINDOW INTO GRADE 10 LEARNERS' GEOMETRIC THOUGHT

Shaheeda Jaffer
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This paper reports on a study of Grade 10 learners' understanding of Euclidean geometry. Learners, taught by two teachers at one South African school, serve as the main research participants. The analysis focuses on learners' responses to one geometry test item. The study is framed by the cognitive science premise that the mind is computational and that propositions serve as the basis for mathematical thought, whether such propositions are considered valid from the point of view of the field of mathematics. The study investigates learners' geometric thought by exploring their logic employed in solutions of geometry problems. The study shows that most learners produced incorrect responses to the test item and that learners fashion propositions that are inconsistent with Euclidean propositions required to solve geometric problems. Furthermore, learners' propositions illuminate a confusion between angle and direction which has its roots in our natural cognitive system used for navigating our environments.

M2023_054b_LP

MATHEMATICS TEACHER EDUCATORS' SELECTION OF EXAMPLES IN PRE-SERVICE TEACHER EDUCATION CLASSROOMS

Justina Longwe-Mandala
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Knowing how to select meaningful examples is an important part of the work of teaching mathematics, and fundamental to the mathematics made available for learners to learn. But how is

selection of examples enacted in pre-service mathematics teacher education classrooms, and how does this enactment help pre-service teachers to know what to consider when selecting examples? This paper shares findings on teacher educators' selection of examples. A qualitative case study approach was employed, whereby, three mathematics teacher educators were observed teaching how to teach place value and addition of whole numbers. They were later interviewed and subsequently had their documents analysed. Data were analysed using the Mathematics Discourse in Instruction framework. Findings indicate that the majority of examples used were those that were selected using in-the-moment decisions and that variation was not considered in the selection of examples. Implications of these findings are discussed.

M2023_043b_LP

INTEGRATING MATHEMATICS AND MUSIC TO SUPPORT FRACTIONAL REASONING ACROSS MULTIPLE CONSTRUCTS: A TASK DESIGN JOURNEY

Tarryn Lovemore, Sally-Ann Robertson & Mellony Graven
South African Numeracy Chair Project, Rhodes University, Makhanda.

This paper shares insight from the three authors' recent twelve-month task design journey. The journey represents an important part of the first author's doctoral study. The aim of the study is to explore integrating mathematics and music in ways that support young learners' development of fractional reasoning. The global COVID-19 pandemic meant that the authors were obliged to undertake much of their task design journey via Zoom and other online platforms. This shift to an increasingly online environment has, we argue, created novel opportunities for how design research data might be collected, captured and thence analysed. An obstacle-resolution cycle is discussed as an example of our task design process.

M2023_035_LP

AN APOS ANALYSIS ON HOW GRADE 10 LEARNERS ENGAGE WITH THE FACTORISATION OF QUADRATIC EXPRESSIONS.

Aubrey Sifiso Vilakazi &. Sarah Bansilal
University of Kwa Zulu Natal

The purpose of this study was to explore grade 10 mathematics learners' explanations of the learning of factorization of quadratic expressions. The participants were 12 learners selected from two secondary schools of Ilembe District in the KwaZulu-Natal Province, who responded to the guided activity, which probed them about the methods they used to explain the factorization of quadratic expressions. Participants were then interviewed about their responses to the items that appeared from the activity. This study was guided by the Dubinsky (1991) Action Process Object Schema (APOS) theory whose roots are informed by the Piaget's theory of constructivism. The study revealed that most learners tend to rely much on the use of short cuts in factoring certain prototype of the quadratic expressions. As a result, learners were unable to factor the trinomial quadratic of $a \neq 1$*, since they perceived the factoring of quadratics as isolated and disconnected procedures. Secondly, there are also students whose mental constructions (conception) are limited to Action levels in terms of APOS theory.*

M2023_047_LP

AN ANALYSIS OF THE EARLY NUMBER SENSE OPPORTUNITIES IN THE GRADES R CURRICULUM AND NATIONAL WORKBOOKS

Lise Westaway, Pamela Vale and Samukeliso Chikiwa
Rhodes University, South Africa

The development of learners' early number sense is regarded as central to learner success as they move up the schooling system. The term number sense is nebulous and contested. Whitacre et al. (2020) argue that this contestation is due to polysemy, and that number sense consists of 3 different constructs: innate number sense, early number sense and mature number sense. The focus of this paper is early number sense, particularly in relation to Grade R curriculum and workbooks. There is a paucity of research on mathematics textbooks in South Africa. In the light of the Covid-19 pandemic and the ensuing lockdown where many learners were reliant on the national workbooks to study, the importance of research on mathematics workbooks becomes important. This paper reports on a data analysis of the Curriculum and Assessment Policy Statement for Grades R mathematics, and the Grades R workbooks. The research asks the question: To what extent is early number sense developed in the Grade R curriculum and national workbooks?

MATHEMATICS SHORT PAPERS, SNAPSHOTS AND POSTERS

M2023_001_SP

PANDEMICS, PSTS, AND PEDAGOGY: FUTURE PROOFING ITE MATHEMATICS EDUCATION

Kevin Larkin, Peter Grootenboer
Griffith University, Gold Coast, Australia

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Initial Teacher Education

This short paper reports on changes to two compulsory mathematics education courses for pre-service teachers (PSTs) that were modified as a response to the Covid-19 outbreak in 2020. The modification required that all elements of the course – lectures, workshops, and tutorials were to be offered fully online. Our findings indicate three main themes arose during course delivery; lecturer presence via video during lectures; modifying content delivery formats to facilitate online lectures, workshops, and tutorials; and, ensuring "access to concrete mathematics materials". Based on end of semester feedback, we were successful in maintaining lecturer presence and the modified delivery methods met student needs; however, we are still iterating in our attempts to incorporate concrete materials in our online pedagogy.

M2023_003_SN

EXPLORING FOUNDATION PHASE PRE-SERVICE TEACHERS' MATHEMATICAL PEDAGOGICAL CONTENT KNOWLEDGE FOR TEACHING ADDITIVE MENTAL MATHEMATICS STRATEGIES

M Kumm, M Graven, L Westaway
Rhodes University

Presentation type: Snapshot
Subject Strand: Mathematics
Area Strand: Tertiary Education

In this snapshot will share some initial findings of the first author's Masters study that aims to investigate third year pre-service teachers' (PSTs') understanding of mental mathematics strategies. The driving research question is: What is the nature of Foundation Phase pre-service teachers' pedagogical content knowledge for teaching additive mental mathematics strategies? This snapshot will argue for the reason why such a study is important. In addition, this study hopes to analyse, highlight and share insights from the Masters inquiry on the nature of the mathematical pedagogical content knowledge for teaching additive mental mathematics strategies of third year pre-service teachers in one institution.

M2023_005_SN

ANALYSIS ON ENDOGENOUS MATHEMATICS CURRICULUM DEVELOPMENT AND REVISION IN MOZAMBIQUE
- THE CASE OF THE 2021 CURRICULUM REVISION-

S. Kusaka
Naruto University of Education

Presentation type: Snapshot
Subject Strand: Mathematics Literacy
Area Strand: Primary Education

Many developing countries have uncritically accepted the mathematics curricula of developed countries as they are. However, this approach has been unsuccessful. This has been a problem since the 1980s. Furthermore, the globalization of education in recent years has further complicated this problem. Appropriate endogenous mathematics curriculum development and revision are key to overcoming this problem. This study analyzes the key factors affecting endogenous mathematics curriculum development by focusing on the 2021 primary mathematics curriculum revision process in Mozambique. It employed the Steps for Coding and Theorization (SCAT) method to evaluate the records of interviews conducted with certain technical officers who were primarily involved in the curriculum revision process. Three key factors for the endogenous mathematics curriculum development and revision were extracted, namely, "deep subject content knowledge," "proper understanding of the schools and children," and "evidence-based discussions."

M2023_007_SP

FEMALE TRAINEE TEACHERS AND INEQUALITY IN MATHEMATICS

C.A. Ali, N.S. Adzifome, E. Asemani
University of Education, Winneba, Ghana

Presentation type: Short Paper
Subject Strand: Mathematics Literacy
Area Strand: Continuous Teacher Education

The issue of inequality in mathematics has lingered for decades and one wonders when we can become satisfied on female participation. With two integrated models, we proposed a two-stage design process to explore female trainee teachers' knowledge and competencies in addressing inequality in mathematics teaching and learning. Samples of 50 female trainees and 200 pupils were involved in this study. Standardized tests were conducted for trainees and pupils to determine the influence of inequality on mathematics teaching and learning outcomes. The results did not only show enormous strengths and weaknesses but also opportunities and threats. Also, the results of the pupils showed that many girls lacked basic knowledge and competencies in mathematics. We therefore concluded that the two models contributed significantly to enriching the teacher trainees' knowledge and competencies in bridging female inequality in mathematics. Consequently, we recommended that stakeholders offer varied assistance, grants and scholarships for female teacher trainees and girls who wish to pursue mathematics professions.

M2023_008_SP

STUDENTS' REFLECTIONS ON LEARNING TRANSFORMATION GEOMETRY IN A COOPERATIVE LEARNING ENVIRONMENT

Angel Mukuka
Mukuba University, Zambia

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Secondary Education

While learners' and teachers' difficulties in handling transformation geometry are well-documented in previous studies, attempts to get feedback from students on the learning environments that can support their understanding of the topic have been sporadic. This study employed a descriptive survey research design in which student-feedback questionnaire was administered to twenty-eight grade 12 learners from one intact class at a private school. The questionnaire was administered after teaching transformation geometry using the Student Teams-Achievement Division (STAD) model of cooperative learning. More than 60% of the respondents regarded all the features of STAD as being effective in supporting their understanding of transformation geometry. Teacher explanations during whole class presentations, quality of questions for small group discussions and oral quiz, and group awards were regarded as the most effective ways for supporting students' understanding of the topic. This demonstrates a need to consider alternative ways of getting feedback from students as traditional assessments like exercises, homework, and tests may not sufficiently highlight what works well for different students.

M2023_009_SP

UNDERSTANDING MATHEMATICAL IDENTITIES OF MATHEMATICAL LITERACY LEARNERS WHO PARTICIPATED IN AFTER-SCHOOL MATHEMATICS CLUBS IN PRIMARY SCHOOL

W.M. Hokonya
Rhodes University

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

This paper reports the mathematical identities of Mathematical Literacy learners who participated in after-school mathematics clubs in primary school. It analyses their stories to understand their sense in pursuing the subject despite storying mostly positive identities in their narratives. It is guided by the research question: What are the mathematical identities of Mathematical Literacy learners who participated in after-school mathematics clubs in primary school? It theorises narrative identities as stories learners tell about themselves (Sfard & Prusak, 2005). I use Solomon's (2009) social and cultural activity analytic framework to analyse the stories. Participants were purposively drawn from 14 high school learners who participated in my PhD study. The findings show student reasoning around their decision to choose Mathematical Literacy and the way their mathematical identities built in after-school clubs carry through to their positive dispositions towards the subject.

M2023_010_SP

AN ANALYSIS OF MULTIPLICATION AND DIVISION WPS IN THREE GRADE 4 SOUTH AFRICAN TEXTBOOKS

K. Hackmack[1], L. Westaway[2]
[1]University of the Fort Hare, [2]Rhodes University

Participation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

The National Curriculum in South Africa emphasises the importance of solving contextual problems in mathematics. The textbook is a dominant resource used within the mathematics classroom and often determines the type of WPs learners are exposed to. This paper examines the nature of the WPs highlighted in three popular Grade 4 textbooks. To do this, we developed a typology as the analytic framework for classifying whole number multiplicative reasoning WPs. This paper addresses the question: What is the nature of the multiplicative reasoning WPs in three Grade 4 South African textbooks? The results indicate significant variation across the textbooks regarding the number, types and subtypes of WPs privileged.

M2023_013_SP

NUMBER TALKS COLLABORATIVE TEACHING AND LEARNING STRATEGY TO IMPROVE TEACHER ASSISTANTS' PERFORMANCE IN NUMBER SENSE

Cloete, G. J. & Rabaza, M.
University of the Free State

Participation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

Number talks teaching and learning strategy has gained popularity in the teaching and learning of mathematics to improve number sense in South African primary schools. This study used number talks as a teaching and learning strategy to improve teacher assistants' number sense. A pre-experimental research design was used to provide number talks as a collaborative teaching and learning strategy to improve teacher assistants' number sense involving multiplication. A voluntary sampling technique was used to select 11 teacher assistants to complete the baseline test, introduced to the number talks teaching and learning strategy, and later completed the post-test on the number sense tasks. Data were analysed descriptively and inferentially. The Cronbach's alpha test was used to find the reliability of the baseline test was determined at 0,75, and for the post-test, 0,40. Results showed a 48.15% increase in average by the teaching assistants in the number sense test with a p-value of 0,000002. Number talks were found to be effective. The study recommends a longitudinal study to ascertain the effectiveness number talks teaching and learning strategies in different contexts.

M2023_015_SP

EXPLORING MATHEMATIZING PROCESSES OF SOUTH AFRICAN LEARNERS FOR SOLVING ADDITIVE RELATION SITUATIONS

Thulelah Blessing Takane
University of the Witwatersrand

Presentation Type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

In this paper, I report on the intentions and adaptations that were made to a small-scale intervention study conducted within a larger study in a Grade 2 isiZulu classroom (7-8 year olds). This school is located within the Wits Maths Connect Primary (WMC-P) project 10 schools. The intervention drew resources developed on principles adapted from the Dutch Realistic Mathematics Education (RME) and the North American Cognitively Guided Instruction (CGI) programmes of research as realized by a series of Big Book of word problems (Askew, 2004). The intervention consisted of a series of 13 intervention lesson conducted with the intervention group. I argue for a considering of the South African context when applying principles adapted from other settings.

M2023_016_SP

TEACHERS' ENGAGEMENT WITH STUDENTS WHEN USING THE BALA WANDE MATERIALS

Permie Isaac: Bala Wande; Ingrid Sapire
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

In this paper we report on the take-up of the Bala Wande (BW) mathematics programme in Grade 1 schools in three provinces in South Africa. The programme (which is designed to take into account the limitations of scripted lessons, that not everything can go in the print material) provides print materials, mathematical manipulatives and support. Video data (19 recorded lessons) was collected at high fidelity project schools, coded and analysed. The evidence presented in this chapter focuses on the 'talk' in the classrooms and it shows that the materials do support some meaningful engagement in classrooms. Dominance of teacher voice varied across the provinces, answer driven questions dominated and few probing questions were evidenced showing the need for further shifts in practice. These findings will be used to inform the ongoing review of the pilot materials.

M2023_017_SP

LANGUAGE USE BY TEACHERS AND LEARNERS OBSERVED USING THE BALA WANDE MATERIALS

Thobeka Ndamase, Mmapula Seoloana
Bala Wande

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

In this paper we report on the take-up of the Bala Wande (BW) mathematics programme in Grade 1 schools in three provinces. The programme (which is designed to take into account the limitations of scripted lessons, that not everything can go in the print material) provides print materials, mathematical manipulatives and support. The evidence presented in this chapter focuses on the language use in the classrooms. The Bala Wande materials are all bilingual. Teachers were seen to use both pure and mixed language with more evidence of translanguaging than code-switching in the observed lessons. These findings will be used to inform the ongoing review of the pilot materials.

M2023_018_SP

MOVING AWAY FROM COUNTING AS AN OPERATION STRATEGY: PRELIMINARY EVIDENCE FROM THE BALA WANDE PROGRAMME

VP Mafilika and L Sako
Funda Wande / Bala Wande

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

In this paper we report on the take-up of the Bala Wande (BW) mathematics programme in Grade 1 schools in three provinces. The programme (which is designed to take into account the limitations of scripted lessons, that not everything can go in the print material) provides print materials, mathematical manipulatives and support. The evidence presented in this chapter shows that certain learnings are taking hold and shifting practice. Findings showed that teachers in all provinces used the structured manipulatives to support the development of number sense that is scripted into the programme. In the Eastern Cape and Limpopo, the use of rote counting was less than in the Western Cape where traditional mental mathematics routines were still dominant. Change is slow but the move away from counting in ones, at least to come extent, was evidenced in this sample of high-agency teachers from the programme schools.

M2023_019_SN

EXPLORING THE NATURE OF CLASSROOM ENVIRONMENTS CREATED BY MATHEMATICS TEACHERS WHEN TEACHING MENSURATION FOR LAE-ORIENTED CURRICULUM

S. Raphoka, B. Mofolo-Mbokane
University of the Witwatersrand

Presentation type: Snapshot Paper
Subject Strand: Mathematics
Area Strand: Secondary education

Learner solitary engagement, and active approach to teaching and learning, is of interest in educational reforms. In this line, Lesotho implements a Learner-Autonomous-Environment (LAE)-calling curriculum to mitigate antecedents of low education quality in the old curriculum. Due to bad history on implementation of learner-centred methods in the country, and innovatory nature of LAE in Mathematics education system (in Lesotho context), the study qualitatively investigates the nature of environments teachers create as they implement the LAE in Mathematics classroom. It involves interviewing six Grade-8 Mathematics teachers on their understanding of their role in LAE and observing their pedagogical practices and learners' engagements to explore presence and effectiveness of Learner Autonomy. Guided by analytical framework (using Curricular aspects, Commognition and Agentic Engagement Theories) the study is at data analysis stage where a qualitative codebook is developed with codes from analytical framework and inductively acquired codes from two-teachers' data.

M2023_020_SP

LEARNERS' PRODUCTIVE DISPOSITIONS: THE CASE OF AN AFTER-SCHOOL MATHEMATICS CLUB

Lovejoy Comfort Gweshe & Karin Brodie
University of the Witwatersrand

Presentation type: short paper
Subject strand: mathematics
Area strand: secondary education

Productive dispositions are an important part of mathematical proficiency and are developed through learners' experiences with mathematics. Mathematics clubs are usually intended to develop learners' productive dispositions through problem-solving and sense-making activities in mathematics. In this paper, we explore learners' productive dispositions in an after-school mathematics club that encourages learning in the forms of mutual engagement, meaning-making, identity construction and belonging. The study employed a qualitative research design. A group of Grade 10 learners' responses to five impromptu questions about their views of their mathematical experiences at the club were analysed. Results show that the club offered learners conditions suitable for learning mathematics and developing their productive dispositions.

M2023_021_SP

BLENDING REALISTIC MATHEMATICS EDUCATION AND RELATIONAL PARADIGMS FOR CONTEXTUAL PROXIMITY IN SOUTH AFRICA

Herman Tshesane, Hamsa Venkat, & Mike Askew
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

In this paper, we share our theories about the power of blending paradigms to design and analyse an intervention lesson sequence focused on additive word problem solving in South Africa. We selected and synthesised paradigms from Freudenthal's Realistic Mathematics Education and Polotskaia's Relational Paradigm, choosing these particular paradigms based both on prior research and our classroom experiences where we found working with a single paradigm less useful for making a difference to learning outcomes. We argue that it was the synthesis of these two paradigms in the design and implementation of an intervention that had 'proximity' to local classroom cultures and conditions that facilitated positive learning gains.

M2023_022_PO

THE USE OF GEOGEBRA BY MATHEMATICS PRE-SERVICE TEACHERS IN THEIR LEARNING TO TEACH FUNCTIONS

J.A Bouwer, E.D Spangenberg, V Ramdhany
University of Johannesburg

Presentation type: Guided Poster
Subject Strand: Mathematics
Area Strand: Tertiary Education

Many students enroll into university courses lacking fundamental knowledge of functions, often because of their exposure to traditional approaches to mathematics teaching. However, research shows that educational technology such as GeoGebra creates an environment where mathematics can be taught in a creative and innovative way. Moreover, various representations of the function concept can be demonstrated by means of GeoGebra, which can contribute to the conceptual understanding of mathematical functions, as well as support collaboration and promote student-centred teaching approaches. Thus, this study aims to investigate the interpretation of the use of GeoGebra in the learning to teach functions by mathematics pre-service teachers. In this qualitative study, 35 mathematics pre-service teachers were purposively selected as participants. Furthermore, this study was framed by the conceptual framework developed by Shadaan and Leong (2013), abbreviated as T2S4VU, and underpinned by Vygotsky's social constructivist theory.

M2023_026_SP

MALAWIAN SECONDARY MATHEMATICS TEACHERS' UPTAKE OF EXPLANATORY COMMUNICATION DURING LESSON STUDY

L. Mwadzaangati
University of Malawi, University of Witwatersrand

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Secondary Education

In this paper, I explain how Malawian secondary mathematics teachers took up on explanatory communication aspect of Mathematics Teaching Framework in recalling knowledge for teaching similar triangles. Analysis of the lesson plans, lessons and lesson reflection transcribed data showed that although the teachers experienced and advocated engagement of learners in more mathematical talk and thinking during the professional development (PD) workshops, lesson planning sessions and in the lesson plans, it was not trivial for them to implement this in the classroom. Thus, revealing tension between what the teachers are used to do when recalling knowledge and what they learn during PD. Confirming that it is not easy for teachers to shift from their usual practice of explaining mathematics concepts to learners to involving learners in deep mathematical thinking and talking about their thinking.

M2023_029_SP

VIDEO CLIPS AS AN ADDITIONAL FACILITATOR FOR LESSON STUDY REFLECTIONS BY IN-SERVICE TEACHERS

Roger G. Metelerkamp, Robert L. Kraft
Rhodes University

Presentation Type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

The broader research I draw on in this paper explores, through an explorative case study, foundation and intermediate phase mathematics in-service teachers' reflective practice mediated through participation in a local community of inquiry of teacher driven lesson study. In this short paper I focus on the narrative of two teachers' learning when using video clips as an additional facilitator for reflection on practice when participating within a teacher driven lesson study.

M2023_030_SP

INTERPRETATION OF MATHEMATICS TEACHERS' EXPLANATIONS ABOUT LEARNERS' MISCONCEPTIONS ZERO WHEN WORKING WITH DECIMAL NUMBERS

M. Rabaza & J. Hamilton
University of the Free State

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Continuous Education

The analysis of learners' misconceptions of decimal numbers is a concern for primary school mathematics teachers. This study reports on the interpretation of mathematics teachers' explanations of the learners' misconceptions when working with decimal numbers. This qualitative research study selected five mathematics teachers' explanations of misconceptions related to decimal numbers identified under a unit of a Numbers, operations, and relationships short learning programme. Data were categorised according to, causes, remedies, prevention, and manipulatives. Data were manually sorted to answer the research questions. The findings show that some mathematics teachers could not explicitly interpret and explain ways of addressing misconceptions through the causes, remedies, prevention, and manipulatives. The SLP will be revised based on the findings

M2023_032_SP

GRADE R TEACHER CHANGING EXPRESSIONS OF THEMSELVES AS TEACHERS OF NUMERACY

Roxanne Long, Mellony Graven
Rhodes University

Presentation Type: Short Paper
Subject Strand: Mathematics
Area Strand: Continuous Teacher Education

In this paper we present an exploration of Grade R teacher expressions of themselves as teachers of numeracy through participation in a numeracy focused professional development (PD) program. Inclusion of Grade R is relatively new following recent policy changes, and current in-service support tends to be subsumed with Grade 1-3 training, without attention to Grade R work that emphasizes, among other aspects, learning through play. This PD focused on specialised teacher knowledge of how to support the development of early number sense through play. The findings reveal that participation in the PD, and access to developmentally appropriate and research informed numeracy resources, supported the shift of teacher expressions of confidence in themselves and greater investment in the teaching of numeracy. The findings contribute to the developing field of Grade R specific PD research and to the field of early numeracy teaching and learning research. In concluding we talk to the implications of this research for PD of Grade R teachers and for policy.

M2023_033_SP

PARENTS' SOCIO-ECONOMIC STATUS PREDICTS MATHEMATICS ACHIEVEMENT IN OR TAMBO INLAND DISTRICT

NK Nogobo, JK Alex
Walter Sisulu University

Presentation Type: Short Paper
Subject Strand: Mathematics
Area Strand: Secondary Education

This paper explores the extent to which parent's socio-economic status predicts Grade 9 learners' Mathematics achievement. A sample of 351 (171 = girls, 180 = boys) participants from six schools (3 = rural schools, 3 = urban schools) Grade 9 Mathematics learners in OR Tambo Inland District in the Eastern Cape participated in the study. Quantitative research approach and correlational research design were used. A standardized test was used to test Mathematics achievement, while a questionnaire was used to test parent's socio-economic status. Both research instruments were tested and found to be valid and reliable. Regression and correlation analysis were performed using SPSS version 28.0.0.0. The findings reveal that parent's socio-economic status predicts Mathematics achievement and regression model is statistically significant. Moreover, results reflect that parent's level of education is the strongest predictor of Mathematics achievement. The regression model shows that the statistical relationship between parent's occupation and Mathematics achievement was not statistically significant. Recommendations are made to all involved stakeholders in Mathematics learning.

M2023_034_SP

USING AN ONLINE SOCIAL MEDIA PLATFORM TO ASSIST PEER LEARNING AND STUDENTS' UNDERSTANDING OF ENGINEERING MATHEMATICS CONCEPTS

Frikkie George
Cape Peninsula University of Technology

Presentation Type: Short Paper
Subject Strand: Mathematics
Area Strand: Tertiary Education

Online social media platforms are becoming increasingly part of educational instruction and gained momentum from the emergency remote teaching and learning strategies implemented during the COVID-19 pandemic. Thus, it is logical that educators should explore the possibilities of applying the affordance of this technology in their pedagogical approaches. This exploratory case study reflects on the use of a social media platform, WhatsApp, used by 180 university of technology first-year students to assist their conception of engineering mathematics topics. This study investigates the interaction of peer-to-peer learning and peer support that took place. A social constructivist approach was used viewing the data through the lens of Toulmin's Argumentation Theory. The data were analysed both qualitative and quantitatively. The findings suggest that the students were keen to assist their peers and that the online social media platform aided their improved understanding of certain engineering mathematics concepts.

M2023_036_SP

AN EXPLORATION OF THE ENABLERS AND/OR CONSTRAINTS WHEN GRADE 3 FOUNDATION PHASE MATHEMATICS TEACHERS ENACT DIFFERENTIATED INSTRUCTIONAL PRACTICES IN THEIR TOWNSHIP CLASSROOMS

Nomzamo Jack and Kenneth M. Ngcoza
Rhodes University

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary Education

Today's teaching space is more diverse than before. As a result, differentiated instruction (DI) is considered helpful in supporting learner diversity, especially in Mathematics classrooms. It is against this backdrop that in this study we sought to investigate the implementation of DI practices by Grade 3 Foundation Phase (FP) Mathematics teachers in their classrooms in township schools. This was a qualitative case study underpinned by an interpretive paradigm. To generate data, the first author observed four FP teachers and focused on how DI teaching practices were made visible through the lens of the Theory of Practice Architecture. Qualitative data were analysed inductively. The findings of the study revealed that the four FP Mathematics teachers varied in how they enacted DI in their classrooms. The study thus recommends that there is a need to enhance FP Mathematics teachers' understanding of DI and how to enact it.

M2023_037_SP

EXPLORING THE POTENTIAL OF HOW *GEOGEBRA* SOFTWARE CAN BE USED AS A VISUAL MEDIATOR BETWEEN PRESERVICE TEACHERS' MATHEMATICAL PEDAGOGICAL CONTENT KNOWLEDGE AND TEACHING PROFICIENCY

A.H. Ngwabe, M. Shäfer
Rhodes University

Presentation type: Short Paper
Subject Strand: Mathematics Education
Area Strand: Tertiary Education

This paper is part of a larger ongoing PhD project, which involves a group of 10 University third year BEd (FET) mathematics preservice teachers as participants. These preservice teachers were trained on how to develop and use GeoGebra applets suitable to teach grade 10 algebraic functions and analytical geometry. We argue that mathematics preservice teachers should be trained both in the knowledge of the subject matter and the knowledge of teaching (which includes using ICT technology) when they begin their teaching professions. This paper provides findings obtained from the teaching practice exercise of the 3 preservice teachers, on how they facilitated mathematical content knowledge using GeoGebra software. Secondly, the paper provides a brief overview of how the use of GeoGebra influenced preservice teachers' proficiency in teaching mathematics. Lastly, an overview of the 3 preservice teachers' perspectives views about their experiences of teaching mathematical content through integrating GeoGebra software is discussed.

M20023_038_SP

THE USE OF LESSON STUDY IN DEVELOPING GRADE 1 TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE

N Kgothego, L Westaway
Rhodes University

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary and Continuous Teacher Education

Teachers' limited pedagogical content knowledge is provided as an explanation for learners' underperformance in mathematics in South Africa. Appropriate professional development programs are required to improve teachers' pedagogical content knowledge. Lesson Study is gaining appeal as a professional development programme. Using a qualitative case study approach, four Grade 1 teachers worked collaboratively to develop their pedagogical content knowledge to support learners' understanding of division word problems. During the Lesson Study process, data was generated through observations, interviews and document analysis. The Knowledge Quartet framework was used as an analytic and explanatory tool. This research showed that participation in the interactive cycles of Lesson Study provided the teachers with an opportunity to develop their Foundation Knowledge but curtailed their Contingency Knowledge.

M2023_040_SP

A DESIGN RESEARCH INTERVENTION FOR NUMERIC EQUATIONS: WHAT PROMISE DOES IT HOLD FOR IMPROVING TEACHING AND LEARNING OF EQUATIONS?

Shikha Takker, Craig Pournara, Iresha Ratnayake
University of the Witwatersrand

Presentation type: Short Paper
Subject strand: Mathematics
Area strand: Secondary Education

Learners' difficulties with algebraic equations are well-known. We designed a research- informed teaching module on numeric equations to aid Grade 7 learners' transition to solving algebraic linear equations. Using a design-research approach, data was collected through two cycles of teaching intervention, first in South Africa (SA) and then in India. The preliminary findings indicate that the module encouraged learners to: explicitly treat the equal sign as a balance; formulate and test conjectures on generalised numeric statements; and reason with inverses (and inverse operations) when moving terms on either side of the equal sign. The study shows the methodological potential of using design research for the development of teaching interventions and associated educative materials for teachers. It also shows the pedagogical potential of an intervention designed using inputs from research and practice.

M2023_041_SP

WHAT DO MATHEMATICS TEACHER EDUCATORS IN GHANA CONSIDER TO BE IMPORTANT FOR THEIR WORK IN PRE-SERVICE MATHEMATICS TEACHER EDUCATION?

Frank Kwarteng Nkrumah & Craig Pournara
University of the Witwatersrand

Presentation Type: Short Paper
Subject Strand: Mathematics
Area Strand: Initial Teacher Education

In this short paper, we zoom in on a professional learning community of three mathematics teacher educators in Ghana's initial teacher education. We provide a descriptive account of common themes that emerged from a focus group interview. We draw on Desimone's (2009) framework of effective teacher professional development in analysing the interview responses of the three mathematics teacher educators. The following themes emerged: mathematical content focus, curriculum alignment, active learning and collective participation. The findings also showed that mathematics teacher educators do not work in isolation but treat professional dialogue as generative opportunities for reflection and learning.

M2023_044_SP

UNDERSTANDING THE SLOW 'MULTILINGUAL TURN'

Sally-Ann Robertson & Mellony Graven
Rhodes University

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary education

Post-1994, South Africa's constitutional commitment to multilingualism translated into a language in education policy that aligned with the principles of additive bilingualism: maintenance of learners' home language(s) plus opportunities for learners to become academically proficient in one or more additional language. Interpretations around freedom of choice relative to the language of learning and teaching have, however, resulted in language practices that deny many South African children the equitable educational opportunity afforded by additive bilingualism. Disjunctions between the language used for teaching and learning and the language spoken at home threaten learners' prospects of meaningful participation in school mathematics. Such disjunctions have been directly implicated in South African learners' low levels of attainment on national and international benchmarking assessments of their mathematical proficiency. In this short position paper, we explore some of the factors that appear to have contributed to our education system's slow uptake of more equitable, multilingual pedagogies.

M2023_045_SP

ANALYSIS OF ERRORS MADE BY GRADE 10 LEARNERS IN SIMPLIFYING ALGEBRAIC EXPRESSIONS

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Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Secondary education

This paper reports on the study which investigated errors made by Grade 10 learners when simplifying algebraic expressions. Sixty-one (61) Grade 10 learners from three secondary schools in the Motheo District of the Free State Province took part in the study. To analyse algebra errors, a mixed methods sequential explanatory design that employs both quantitative and qualitative approaches was used. A 12-item pen-and-paper test was administered to 61 participants during the quantitative phase. The most common errors made by respondents were identified and categorised. The errors identified during the study are: Fraction errors, non-recognition of common factors, Factorisation errors, conjoin errors, Substituting letters by numeric values, and Misapplication of the rules. Interviews with selected participants were conducted during the qualitative phase. The interviews focused on each identified frequent error to determine why learners committed the identified errors.

M2023_046_SP

A PROBE INTO THE GEOMETRIC SKILLS OF A SELECTED GRADE 11 MATHEMATICS CLASS: A CASE STUDY

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Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Secondary Education

In South Africa, research has shown that learners had had poor geometric understanding over a number of years, and this has since been a matter of concern. Research previously conducted pointed out the lack of problem-solving skills in learners as one of the contributing factors to poor understanding of geometry. This study focuses on finding prior geometric skills learners bring to the classroom before introduced to grade 11 content. This case study grounded within an interpretive paradigm and informed by the social cognitive learning theory. Data was collected using a test administered to 20 grade 11 learners that was then analyzed qualitatively and quantitatively. Study findings revealed that majority of learners were not having significant geometric skills prior to learning grade 11 Euclidean geometry content and that the few learners that applied some skills did that incorrectly or inappropriately in most cases.

M2023_049_SP

A COLLABORATIVE INTERVENTION THAT SEEKS TO DEVELOP GRADE ONE MATHEMATICS TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE

Stella Mutlane and Lise Westaway
Rhodes University, South Africa

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Continuous Teacher Education

This study aims to ascertain how a collaborative intervention can widen teachers' pedagogical content knowledge as they develop learners' early number sense. The Knowledge Quartet framework provide the explanatory and analytic tools for the research. This qualitative case study was conducted at a Quintile 3 public primary school in the Northern Cape with three Grade One teachers. Data was collected through interviews, classroom observations, and videos of collaborative lesson planning and reflection sessions. Key findings of this research are that teachers had limited knowledge of early number sense and how to develop learners' numbers sense, however, despite this, they found the opportunity to work collaboratively beneficial.

M2023_051_SP

MODES OF REASONING PRESENTED IN TWO 9TH GRADE MATHEMATICS TEXTBOOKS EXPLANATIONS ON THE TOPIC OF LINEAR GRAPH IN SOUTH AFRICA

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Presentation Type: Short Paper
Subject Strand: Mathematics
Area Strand: Secondary Education

In this empirical paper, I discuss the modes of reasoning presented in two Grade 9 mathematics textbook explanations on the topic of linear graphs. In 2018, the TIMSS report revealed that Grade 9 learners struggled to answer questions that require mathematics reasoning skills, particularly on the topic of linear graphs. This issue is also highlighted in the DBE diagnostic reports of the year 2019 to 2021. In this paper, I amalgamated two theoretical frameworks- modes and reasoning and the multiple representational translation models to respond to the highlighted issue by interrogating the following questions: What are the modes of reasoning in two Grade 9 mathematics textbook explanations on the topic of linear graphs? How can teachers/textbook developers use the multiple representational translation models to enhance opportunities to learn reasoning skills on the topic of linear graphs? The findings indicate that linear graphs are presented in a manner that promotes procedures, with limited opportunities to learn elements of mathematics reasoning. In considering this, textbook developers/ teachers are advised to focus on linking the nuances of different representational aspects that emanate from the multiple representational translations model to enhance the activity of reasoning in linear graphs when textbooks are designed and when teachers prepare lesson plans.

M2023_053_SN

VIRTUAL TEACHING FRACTION ALGORITHMS FOR EDUCATIONAL PRODUCTIVITY TO FOUNDATION PHASE LEARNERS IN OR TAMBO INLAND DISTRICT PRIMARY SCHOOLS

Nozuko Nqabeni
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Presentation type: Snapshot Paper
Subject Strand: Mathematics
Area Strand: Primary Education

In the Eastern Cape's OR Tambo Inland District, this study will be carried out. The application of virtual teaching fraction algorithms to grade 3 learners will be explored by the researcher. A mixed method will be used for methodology to determine the predominant use of virtual teaching by grade 3 teachers. Twenty primary school principals, departmental heads together with mathematics teachers from within the district will participate in the study then qualitative and quantitative methods will be incorporated. The pragmatic paradigm will be utilized in this study. It will be expected that parents, legislators, and policymakers would be informed about the findings of this study.

M2023_056_SP

MATHEMATICAL INSIGHT OF STUDENTS A PRESERVICE PRIMARY SCHOOL EDUCATION PROGRAMME

BJL Brown
Rhodes University

Presentation Type: Short Paper
Subject Strand: Mathematics
Area Strand: Initial Teacher Education (Primary)

Deficits in South African mathematics education are widely acknowledged. To contribute to a solution, the National PrimTEd project aimed to improve the mathematics education of Primary Preservice Education students. This paper presents the orientation and conceptual design, arising from a process of design research into an introductory mathematics course for a Primary Preservice Education Programme. The course objective is to engage students in an alternative experience of 'doing mathematics', that explicitly focuses on developing mathematical insight. A broad view of Primary mathematical insight is taken, seeing it as arising from systems of links between practical experience and perception; different forms of presentation (graphical, textual and symbolic); and structured mathematical thinking.

The paper discusses the formulation of tasks for student engagement and assessment, that explicitly incorporate and relate these different elements, by combining sub-questions that focus on particular elements. Results of initial benchmark and midyear assessments for the 2022 cycle of this course, are then presented. These preliminary results indicate positive student learning along a number of different dimensions, as well as some remaining shortcomings in the course, and point to some possible interaction effects.

M2023_060_SP

AN ANALYSIS OF FRACTION WORD PROBLEMS IN INTERMEDIATE PHASE LEARNER BOOKS

Nkazimulo I. Zitha and Anthony A. Essien
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Primary education

The study aimed at analysing fraction word problems in three intermediate phase learner practice textbooks (Grades 4-6 textbooks). Levels of cognitive demand of tasks merged with Kieren's framework of fractions sub-constructs were used as a merger framework to examine how fraction word problems in each grade learner textbooks are formulated and structured with reference to the five constructs of fractions; and to investigate the potential affordances (and possible limitations) for learner progression in the topic of fractions in the textbooks. Results of our qualitative analysis, contrary to popular belief that primary schools' textbooks focus on only one element of fractions, which is the part-whole concept, revealed that the Scholastic PRIME textbooks' content progression encompasses all the fractional constructs in detail affording learners learning opportunities to engage with all meanings of fractions beyond the part -whole concept. In relation to the hierarchical

content progression, our findings show that the sub-constructs of part-whole, measure, and ratio are included in at least all three Grades, implying that the foundational skills of these concepts are sparingly continued at each grade level, with ample practice at the appropriate level of difficulty. The organisation of the fractional concepts demonstrates ease of progression from one concept to the next, using cognitive level appropriate visual representations and models that allowed learners to mathematise in each subconstruct.

M2023_061_SP

AN ANALYSIS OF THE AFFORDANCES FOR LEARNING PROBABILITY IN A COMMONLY USED GRADE 12 MATHEMATICAL LITERACY TEXTBOOK

Sthembile L. Magwaza and Anthony A. Essien
University of the Witwatersrand

Presentation Type: Short Paper
Subject Strand: Mathematical Literacy
Area Strand: Secondary Education

The study reported in this paper set out to examine the patterns of variation in the examples that are present in one commonly used mathematical literacy textbook in South Africa in order to engage with the affordances it offers to learners who use the textbook. A preliminary qualitative study of the topic of Probability in the textbook using the combination of variation theory and the framework for textbook analysis by Valverde et al (2002) revealed that the critical features of the probability topic in the textbook are aligned to the CAPS curriculum. Our analysis also revealed that the presence of the core tenents of variation are limited in the topic of probability. Recommendations are made for the further development of Mathematics Literacy textbooks.

M2023_062_SP

USING RASCH ANALYSIS TO IMPROVE THE FUNCTIONING OF AN ASSESSMENT INSTRUMENT IN LINEAR ALGEBRA

Cathrine Kazunga and Sarah Bansilal
University of KwaZulu-Natal

Presentation type: Short Paper
Subject Strand: Mathematics
Area Strand: Continuous Education

In this paper we explore the use of Rasch Measurement Theory in improving a research instrument for assessment purposes. The instrument was made up of 16 items, with a 3- point scoring rubric for each item, and the items were designed to target Action Process and Object levels of thinking according to APOS theory. We rescored some items post-hoc when the Rasch analysis indicated that the scoring rubric did not work as intended. The rescoring resulted in an improved fit to the Rasch model. A second aim was to investigate whether the empirical ordering of the items described in terms of the item difficulty locations, corresponded to the increasing cognitive complexity of the items predicted by APOS theory. We found there were inconsistencies where some items that were targeting the Action level were experienced as harder than some that were predicted to be suitable for Object level reasoning.

M2023_063_PO

RESEARCH-INFORMED DEVELOPMENT OF ISIXHOSA TEACHING AND LEARNING MATERIALS FOR DOUBLING AND HALVING IN GRADE 3

Tabisa Booi
Rhodes University

Presentation Type: Poster
Subject: Mathematics
Area: Primary education

The research that this poster reflects on is a design-based research project investigating the development of isiXhosa teaching and learning materials for the teaching of doubling and halving in Grade 3. The materials that will be adapted are the English doubling and halving lesson starters from the Mental Starters Assessment Project. This research is in its initial stages and so the poster presents the first iteration of the design of these materials. The research question asked is "How can quality teaching and learning materials be developed in isiXhosa for the teaching and learning of doubling and halving in Grade 3?"

Sc2023_029b_LP

ENHANCING PHYSICAL SCIENCES TEACHERS' PCK THROUGH PROBLEM-BASED LEARNING

Washington Dudu
North West University

Most science teachers possess a relatively good content knowledge but limited pedagogical content knowledge (PCK). Problem-based learning (PBL) can serve as a vehicle for teachers to examine their PCK as they plan and design PBL experiences for implementation. However, there is problem with formulating and adapting PBL activities in the teaching of three states of matter (TSM). The theoretical framework which underpinned this study was PCK. This study utilised the exploratory qualitative case study approach and was conducted in the North West Province with two physical sciences teachers. Data was generated using PBL knowledge questionnaire, PCK Test, PBL Activity Evaluation Schedule, portfolio and interviews. Saldaña's model was used as the analytic tool. Findings of this study showed a positive shift in physical sciences teachers' PCK after participating in an intervention. This study recommends that physical sciences teachers be given support to enable them to implement PBL in teaching abstract constructs such as TSM.

Sc2023_035_LP

TEACHERS' LEVELS OF USE OF PRACTICAL WORK IN THE PHYSICAL SCIENCES CURRICULUM

Enid Oguoma & Thuthukile Jita
University of the Free State

Curriculum reform relies, in part, on how the implementers respond to the new guidelines and/or prescriptions at local level. The introduction of the Curriculum and Assessment Policy Statement (CAPS) in South Africa was meant to improve, inter alia, the quality of science teaching in schools by introducing guidelines on laboratory experimental work for certain content topics. The purpose of this multiple-case study of four high school Science teachers was to determine their levels of use (LoUs) of the prescribed guidelines. The concerns-based adoption model (CBAM) was used as theoretical framework. Results show that participants' LoUs were mainly at the mechanical and routine-use levels, whereas the refinement level higher up appeared less. In other words, whereas participants managed to introduce experiments in their lessons, their instructional approaches are still not aligned with CAPS guidelines. The study recommends more hands-on professional development in practical work for science teachers.

Sc2023_046b_LP

EXPLORING THE ROLE OF TEACHERS' PROFESSIONAL LEARNING COMMUNITY AND COMMUNITY EXPERTS TO EMERGE HYBRID SCIENCE PEDAGOGICAL STYLES

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This study explored the use of a Grade 10 Physics teachers' professional learning community (PLC) and community experts to bridge learners' life-worlds and science cultures. The PLC members are often positioned as cultural knowledge brokers since they help learners make sense of curricular content. To supplement Vygotsky's Sociocultural Theory, we used Ogunniyi's (2007) Contiguity Argumentation Theory as a lens in this study. Data were gathered using semi-structured interviews and participatory observations. A bottom-up approach entailed working with teachers to tap into the cultural heritage of the community members rather than relying on 'one-size-fit-all' and once-off workshops run by the Department of Education (top-down approach). The findings revealed that the Grade 10 physics teachers had acquired the relevant skills to be able to integrate indigenous knowledge (IK). For instance, Kaurungi explained that the IK of sitting around the fire during the sharing circles can be used to explain convection as the flow of heat. Thus, it is recommended that teachers should work in partnership with expert community members as custodians of IK to learn which IK could be integrated into their teaching.

Sc2023_021_LP

UNDERSTANDING EXPERIENCED PHYSICS TEACHER'S ENACTED PEDAGOGICAL CONTENT KNOWLEDGE WHEN TEACHING FORCE CONCEPTS

Marake, Loyiso C Jita & Maria Tsakeni
University of the Free State

Pedagogical content knowledge affords teachers opportunities to notice and act on classroom events that have the potential to increase understanding. The purpose of this paper was to investigate enacted pedagogical content knowledge of one physics teacher when teaching force concepts. The enacted pedagogical content knowledge framework that is characterised by teacher's ability to notice and act on classroom events informed this study. This was a qualitative case study of one physics teacher who was purposely selected from three teachers who were observed while teaching the topic. The pedagogical content knowledge episodes where the teacher acted on classroom events were extracted from the lesson transcripts. The results indicated that the teacher's enacted pedagogical content knowledge was linked to knowledge of how students learn; representations of force concepts and content knowledge. Thus, the results suggest that the teacher's enacted pedagogical content knowledge needs to be developed further so that he can integrate other professional knowledge when teaching force concepts.

Sc2023_041b_LP

PERFORMANCE DIFFERENCES OF GRADE 8 NATURAL SCIENCES LEARNERS TAUGHT IN HOME LANGUAGE AND SECOND LANGUAGE

Lydia Mavuru
University of Johannesburg

The study determined the differences in the performance of grade 8 learners who were taught Natural Sciences in their home language (Afrikaans) and those taught in English (second language). In a sequential mixed method research design 200 grade 8 learners and their four teachers were selected to participate in the study. Quantitative data was collected through the analysis of learners' scores in three of the formative assessments administered by their teachers and qualitative data was obtained from the analysis of learners' responses to open ended questions. Quantitative and qualitative data were analysed statistically and content analysis respectively. Findings showed that learners taught in the second language performed better than those taught in their home language and that learners who learned in a second language (English) could express themselves better than those learning in home language (Afrikaans). Findings have implications on language in education policy and pre-service and in-service teacher development.

SC2023_007_LP

TEACHERS' EXPERIENCES OF THE enactment OF formative assessment in PHYSICAL SCIENCES teaching and learning

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The study explored in-service teachers' experiences of the use of assessment for learning in Physical Sciences teaching and learning. The empirical investigation adopted a generic qualitative design and involved twelve purposively selected Grade 10 Physical Sciences teachers from South African township schools. Qualitative data were collected through semi-structured focus group interviews and classroom observations. The study is underpinned by the Assessment for Formative Purposes Cycle as the underlying theoretical framework. The teachers demonstrated ambivalent disposition in terms of their experiences of the enactment of formative assessment in Physical Sciences teaching and learning. While Physical Sciences teachers expressed fundamental appreciation of the affordances of formative assessment as a pedagogical tool, they bemoaned lack of professional expertise required to harness pedagogical benefits of formative assessment. Classroom observations revealed that teachers struggled to employ appropriate scaffolding techniques that could potentially ameliorate coherent enactment of formative assessment in Physical Sciences teaching and learning. While teachers collected evidence related to learning goals when enacting formative assessment, the interpretation of evidence for purposes of making judgment of achievement remained an arduous task. Theoretical implications for pedagogic innovation are discussed.

Sc2023_064_LP

INVESTIGATING THE IMPACT OF A RUBRIC GUIDED WORKSHOP ON THE CONTENT KNOWLEDGE FOR CELL CYCLE AND BIODIVERSITY TOPICS AMONG IN-SERVICE GRADUATE BIOLOGY TEACHERS: A CASE STUDY

Joe P Mukaro, Eunice Nyamupangedengu & J Kaifa
University of Zimbabwe; University of the Witwatersrand; Midlands State University

The results reported in this paper are part of an ongoing large-scale research on the need to improve teachers' science teaching practices under changing environments such COVID-19 pandemic. This research aimed to examine the level of content knowledge (CK) using an active learning workshop approach. A mixed method approach was used in which eight in-service teachers were purposely selected from Manapol province. A workshop series was organised for them with the aim of strengthening both their content knowledge and how to teach that content. Participants were initially exposed to a pre-test on the content knowledge on cell and nuclear division and biodiversity. Their performance scores on the pre-test were recorded and later they were exposed to a rubric for content knowledge development for five workshop days. A post-test was used to determine their content knowledge on the same topics and their performance scores were recorded. Both quantitative and qualitative approaches were used to analyse the results. Both approaches confirmed that there was a significant improvement in content knowledge among participants on the two topics. The rubric for content development used through a workshop series had a significant impact on the in-service teachers' development of content knowledge in the biology topics studied.

SC2023_085B_LP

WORLDVIEWS HELD AMONG PRE-SERVICE SCIENCE TEACHERS IN FIVE NON-WESTERN COUNTRIES

Meshach Ogunniyi
University of Western Cape

People hold different worldviews to depict their predispositions towards diverse phenomena. This study, as part of a larger study, explores the nature of worldview presuppositions among pre-service science teachers (henceforth, subjects) in five nonwestern countries namely, Brazil, Egypt, Japan, South Africa and Zimbabwe. It also examines possible impact of such worldviews on their instructional practices. Data derived from a questionnaire were analyzed thematically using Kearney's (1984) logico-structural model and the contiguity argumentation theory proposed by Ogunniyi (2007a). The two theoretical frameworks also served as units of analysis for the study. The findings showed that the subjects: (1) projected a multiplicity of worldviews which they deployed in a variety of ways; (2) believed that the scientific and the indigenous worldview presuppositions played important roles in their daily lives; and (3) mitigated conceptual conflicts in a variety of ways to attain cognitive harmonization. The implications of these findings for science education are highlighted in the paper.

Sc2023_014_LP

THE "UNHEARD VOICES": EXAMINING FACTORS THAT CONTRIBUTE TO THE POOR PERFORMANCE OF GRADE 12 LIFE SCIENCE LEARNERS IN RURAL SCHOOLS IN THE EASTERN CAPE REGION

Thamsanqa Sihele
Walter Sisulu University

The high failure rate among learners in rural schools significantly affects their pursuit of higher education. Socio-economic drawback within the South African rural school setting persists in crumbling infrastructure and lack of sanitation, laboratories, and resources. The research used focus group interviews, individual interviews, and learner-reflective journals to generate data from 20 purposively selected Grade 12 learners from two rural high schools. Findings revealed that the lack of parental involvement, shortage of learning materials, overloaded Life Sciences curriculum, learners' ambitions and motivations, and the ability to relate Life Sciences to everyday life were the key factors affecting learners' performance in the subject. The study recommends that SGBs and teachers collaborate to guarantee that learners can access suitable learning materials. Time must be allocated to teaching and learning Life Sciences. Furthermore, qualified, competent teachers must be appointed to teach Life Sciences in rural areas. Finally, English should be used as the medium of instruction in classrooms.

SCIENCE – SHORT PAPERS, SNAPSHOTS AND POSTERS

Sc2023_001_SP

PRESERVICE SCIENCE TEACHERS' ENGAGEMENT IN SCIENCE VIA AGRICULTURAL GARDEN PROJECTS: IMPLICATIONS OF SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS PRAXIS FOR EDUCATION FOR SUSTAINABLE DEVELOPMENT

Nadaraj Govender
University of KwaZulu-Natal

Presentation type: Short Paper
Subject strand: Science, Natural
Area strand: Initial teacher, Education

Preservice science teachers' experiences of agricultural garden projects were used to address sustainable food resources. Ninety-five preservice science teachers were involved in this participatory action research project. A second-year university physical science method course module was adapted to include the agricultural project. The interview data were collected through a questionnaire. The United Nations Educational, Scientific and Cultural Organization policy to implement Education for Sustainable Development in the framework of the 2030 Agenda for Sustainable Development was used to analyse the data. The preservice science teachers were positive about including ESD in their disciplines and acquired practical and integrated knowledge about agriculture. The findings have implications to implement UNESCO's Sustainable Development Goals for curriculum transformation, school and community involvement, thus intersecting research, policy and practice for a sustainable Praxis in Science, Technology, Engineering and Mathematics Education.

Sc2023_002_SP

DOES FURTHER-MATHEMATICS PREDICT STUDENTS' PHYSICS PERFORMANCE? A CORRELATIONAL DIAGNOSIS OF THREE YEARS SECONDARY EDUCATION

Olalekan Taofeek Badmus & Loyiso C. Jita
University of the Free State

Presentation type: Short Paper
Subject strand: Science Physics
Area strand: Secondary Education

The awareness and application of the knowledge of Further Mathematics transcends the boundary of Physics as a discipline. The application of further mathematics in physics and vice versa is evident in the curriculum and literature. This study explores the attrition between physics and further-mathematics among senior secondary school students with a view to expose relationship in predictive terms. Ex post facto research of the co-relation was employed to investigate respondents results in West African Senior School Certificate examination (WASSCE). Purposive sampling technique was employed in the selection of 103 participants. PPMC and MANOVA statistical tools were employed in the analysis of data. The study observed a significant relationship in the performance of students offering further mathematics and physics. A further probe along gender and school type were also done in this study. This study established equal cognitive capacity for both male and female learners in the subjects under examination. This study found no significant difference in the performance of learners between urban and rural schools as against the expected norm. We recommend equal opportunity for all gender, as well as provide basis for truce in the debate on public and private schools with respect to performance.

Sc2023_003_SP

REFLECTING ON OWN PRACTICE THROUGH A TEACHER – DEVELOPED SECONDARY SCHOOL SCIENCE TEST IN ESWATINI

Sibusiso Masuku[1], Celumusa Ntshangase[2]
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Presentation type: Short Paper
Subject strand: Natural Science
Area strand: Secondary Education

Tests are an invaluable monitoring and evaluation tool within the education enterprise. The processes involved in test development, therefore, cannot be taken lightly. Evidence-based Grade repetition and school dropout rates have been reported with great national concern in Eswatini, where the nature of tests taken by the learners emerged as a key factor. In this paper we discuss the importance and the purpose of understanding the proper way of developing and using assessments that can effectively determine achievement outcomes of learners. A 40-item multiple binary assessment was administered to 144 Form 2 Science learners in a co-educational government high school in Eswatini. The Kuder-Richardson 21 (KR-21) formula, p-value, point biserial correlation, and discrimination indices were used to analyse the results. KR-21 showed the test instrument to be internally unreliable. Less than half of the 40 items fell within the reasonably good or acceptable value of ranges using item analyses.

Sc2023_004_PO

DEVELOPING ISINDEBELE SCIENTIFIC LANGUAGE REGISTER FOR NATURAL SCIENCES AND ITS CLASSROOM APPLICATION IN SOME CLASSES IN THE SIYABUSWA 2 CIRCUIT, SOUTH AFRICA.

Thuli G. Ntuli and Awelani V. Mudau
University of South Africa

Presentation type: Poster
Subject strand: Natural Sciences
Area strand: Primary education

The purpose of this study is to develop isiNdebele scientific language register for Natural Sciences and classroom its application in some classes in the Siyabuswa 2 circuit, South Africa. Since the use of indigenous languages in education has become a pertinent issue in South Africa. Introducing indigenous languages as medium of instruction in South African schools wherein learners will be taught and learn in their mother tongue is one of the is one the Department of Education's visions. However, that vision will not be realised if there are no adequate resources such as language teachers, teaching and learning materials offered in indigenous languages. The above factors made the researcher realise the significance of conducting this study. This study will be guided by the following research questions: "What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application"? What are the stakeholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science? And How did the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses? Consequently, this study is aimed at adding a resource which will advance the vision of the DBE. The study will follow a qualitative approach.

Sc2023_005

WHAT DOES THE COVID PANDEMIC MEAN FOR TEACHING IN LIFE SCIENCES?

Martin Braund
Nelson Mandela University

Presentation type: Short Paper
Subject strand: Sciences - Biology
Area strand: Secondary education

The educational world has been severely impacted by the COVID-19 pandemic. This positional paper deals with one positive outcome: how lessons from the pandemic might shape, for the better, future teaching in the 'Life Sciences'. Four overlapping spheres of learning are proposed that emerge from our experiences of COVID-19 and are ripe for change: core knowledge about disease, epidemiology, the environmental origins of zoonotic disease and critical thinking and literacy required to help engage with the social practices of life sciences within the social-political milieu. The epistemological and pedagogical stance called for is one that challenges traditional neo-conservative traditionalism and technical-instrumentalism, to propose instead, a re-evaluation of teaching and learning based on social justice and informed critical literacy that ultimately leads to and provides emancipatory knowledge.

Sc2023_006_SP

IMPOSTOR PHENOMENON AMONG BIOLOGY EDUCATION RESEARCHERS: AN EXPLORATORY STUDY

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Indian Institute of Management Ahmedabad, India

Presentation type: Short paper
Subject strand: Biology
Area strand: Tertiary Education

Impostor phenomenon occurs when successful people cannot internalize their success, attributing it to luck, connections, or other's kindness. The transition from science, technology, engineering, and mathematics fields to discipline-based education research is poorly understood. This exploratory study investigates biology education researchers' experiences of impostor phenomenon in relation to their transition experiences from biology to biology education. Participants were recruited from a listserv using convenience and snowball sampling. Fifteen interviews were analysed thematically using constant comparison. Findings show that participants (all women) experienced impostor phenomenon as they transitioned from biology to biology education research. They perceived under-preparedness and lack of skills needed to thrive in education research. They worried about the everyday politics of their future hire in a biology department as an education researcher that could bring its own challenges such as methodological favouritism (the qualitative-quantitative divide) and the identity divide between biology/biology education. Data analysis is ongoing.

Sc2023_008_SP

EXPLORING STUDENTS' CONCEPTUAL ERRORS REGARDING ATOMIC STRUCTURE IN GRADE 10 PHYSICAL SCIENCE

Kevalan Moodley, Doras Sibanda and Mary-Anne Good
University of KwaZulu-Natal

Presentation type: Short Paper
Subject strand: Science Chemistry
Area strand: Secondary Education

The atomic structure problems experienced by learners are amongst the most complex and difficult in chemistry education. Scientific conceptual errors in threshold topics such as atomic structure hinder learner performance and progression in Physical Science at high school. In an effort to address this critical issue, this study aimed to explore students' conceptual errors regarding atomic structure in grade 10 Physical Science. Data was collected from a validated diagnostic test and 75 grade 10 Physical Science students completed the questionnaire. Four group interviews were conducted with students. Data was analysed using descriptive statistics and content analysis respectively. The preliminary results indicate that students experienced learning difficulties associated with atomic models, atomic structure and electron configuration. The findings of this study illustrate the need for developing teaching and learning strategies that will remediate these student conceptual difficulties to improve students' understanding of the atom and related chemistry topics.

Sc2023_009_SP

THE EFFICACY OF A HEURISTIC APPROACH FOR GUIDING PRESERVICE NATURAL SCIENCES TEACHERS' PLANNING OF AN EXPERIMENTAL INVESTIGATION

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Presentation type: Short Paper
Subject strand: Science, Natural Sciences
Area strand: Initial Teacher Education

This is a mixed method survey of the efficacy experienced by two student cohorts (n=49, n=51), of a four-month-long self-study preservice Natural Sciences teacher course designed around a heuristic for planning an experimental investigation. Data collected includes Likert-scale and open-responses regarding perceptions of this heuristic's value, group interviews, written work, and pre- and post-answers to the Student Understanding of Science and Scientific Inquiry questionnaire. Descriptive and inferential statistical analyses were performed. All the students were able to design an investigation of acceptable coherence and rigour, with the heuristic generally perceived as instrumental in this. Statistically significant increases were found in the naïve view of a single valid method, and the sophisticated view that science involves creativity and imagination. The findings are explained in terms of the Knowledge in Pieces Theory, and suggestions are given regarding the role of heuristics related to the scientific method in introductory science courses.

Sc2023_010_SP

EXPLORING THE TEACHING OF CHEMICAL EQUILIBRIUM IN NAMIBIA: A FOCUS ON THE CHALLENGES AND SOME MITIGATION STRATEGIES

Tasara Manamike, Kenneth M. Ngcoza
Rhodes University

Presentation Type: Short Paper
Subject Strand: Science Chemistry
Area strand: Secondary Education

Teachers in Namibia consider chemical equilibrium as one of the most difficult topics to teach. Unsurprisingly, Grade 12 students seem to habitually fail questions on chemical equilibrium. This persistent error in student understanding indicates problems in the teaching methodologies, that is, the poor students' results could be due to their teachers' lack of pedagogical content knowledge (PCK). It is against this backdrop that we studied the challenges that teachers face in teaching chemical equilibrium and the mitigation strategies that they employ. We employed topic-specific PCK as a theoretical framework for this qualitative case study which was underpinned by the interpretivist paradigm. Qualitative data were generated from four Chemistry teachers using semi-structured interviews. The data, analysed using a thematic approach, revealed numerous problems in the teaching and learning of chemical equilibrium and some effective mitigation strategies. However, these strategies seem inadequate and we, therefore, recommend teacher professional development.

Sc2023_012_SP

STUDENTS' PERCEPTIONS OF A "BOOTLEGGING OF ALCOHOL" PRACTICAL IN THE CONTEXT OF THE COVID-19 PROHIBITION AND INDIGENOUS KNOWLEDGE

Christine Mundy and Boitumelo Nokeri
University of Pretoria

Presentation type: Short Paper
Subject strand: Science Chemistry
Area strand: Tertiary Education

A student's attitude plays a crucial role in their learning process; therefore, it is imperative that student perspectives be understood. In this study, investigations were done to assess whether meaningful learning occurs in a novel context-based chemistry experiment. The new lab practical included chemical content knowledge on Matter and Separation, and drew on myths, contextual and indigenous knowledge regarding alcohol production and consumption. An online voluntary pre- and post-lab questionnaire based on the Meaningful Learning in the Laboratory Instrument (MLLI) was used to gather data on students' expectations and experiences. Two items were added to the questionnaire to probe students' thinking in terms of chemistry beyond the lab and indigenous knowledge. The pilot study showed students' affective and contextualized expectations were exceeded by their experience, however cognitive expectations were not met. The full-scale study will take place in 2022.

Sc2023_016_SP

CONTENT KNOWLEDGE FOR TEACHING SCIENCE MADE EXPLICIT: A CASE WITH ORGANIC CHEMISTRY

B.P. Ndlovu, E.M. Mavhunga
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Chemistry
Area Strand: Initial teacher education

This is a conceptual paper which presents a conceptual argument for defining the content knowledge that teachers need to teach School subjects and build their pedagogies from. It conceptually revisits the most important question about the nature of the science content knowledge that teachers should know to teach secondary school subjects, and as a precursor for the development of good pedagogical content knowledge. It synthesizes previous arguments about the issue and embeds them within the curricular position of powerful knowledge. Invoking Shulman's idea of transforming content knowledge, the paper asserts that the base content knowledge from which the transformation of content into learner understandable versions is a distinct content knowledge from both the academic discipline and school subject. It postulates a version of content described as Teacher-related Science Content Knowledge (TerSCK) through organic chemistry.

Sc2023_018_SP

PHYSICAL SCIENCE TEACHERS' EXPERIENCES WITH ACCELERATED TEACHING AND LEARNING POST COVID-19 DISRUPTIONS

Macheli Mofolo[1], Sechaba Koma[2] & Sikeme Raphoka[2]
Lesotho College of Education[1] & National University of Lesotho[2]

Presentation type: Short Paper
Subject Strand: Natural Science
Area Strand: Secondary education

The COVID-19 pandemic forced schools to be closed, resulting in the loss of teaching and learning time. To mitigate this, the Ministry of Education and Training, Lesotho, introduced accelerated teaching and learning (ATL). Since then, little is known about Physical Science teachers' experiences of integrating practical work (PW) in teaching through ATL. Consequently, four secondary school Physical Science teachers were purposely selected from four schools to respond to semi-structured interviews. The data was deductively analysed using the sub-concepts from Woodley's (2009) framework for practical science. The findings indicate that teacher-centred methods that are not in line with the constructs of the framework were used. Although the teachers were able to teach the theory part of the subject, ATL did not allow them enough time to carry out PW. Teachers should be trained on how to accommodate PW within ATL, should there be a need for ATL in future.

Sc2023_020_SP

ESTABLISHING HOW BLENDED LEARNING INFLUENCED PHYSICAL SCIENCE PRE-SERVICE TEACHERS' SELF-EFFICACY AND MOTIVATION

Mohafa L. G., Makhechane M. and Qhobela M.
National University of Lesotho

Presentation type: Short Paper
Subject strand: Natural Science
Area strand: Tertiary Education

This paper reports on how the self-efficacy beliefs of sixteen physical science pre-service teachers were influenced by blended learning. The study used a mixed method approach. to respond to the research question: How has blended learning influenced physical science teachers' self-efficacy and motivation during teaching practice. Data were collected through questionnaires and interviews and analyzed using SPSS and content analysis methods Preliminary analysis revealed that the blended learning affected the pre-service teachers positively, since their overall self-efficacy score levels were above average. The findings suggest that the training of PSTs through blended teaching and learning may provide them with enough knowledge to accomplish the teaching practice tasks effectively. The study recommends amongst other things that, pre-service teachers should be offered opportunities to experience blended learning as part of their training.

Sc2023_022_SP

INFLUENCE OF AN ADAPTED LESSON STUDY APPROACH ON LESSON DEVELOPMENT OF PHOTOELECTRIC EFFECT

Biyela Zenest Ntshangase and Jeanne Kriek
University of South Africa

Presentation type: Short Paper
Subject Strand: Science, Physics
Area Strand: Secondary Education

Lesson study approach has improved teaching and learning. This explanatory case study research design was used to explain the influence of an adapted lesson study approach on lesson development of photoelectric effect. The adaptation of the lesson study within this study allowed implementation of lesson study within the local context. Social constructivism underpins the current study. Four teachers participated in the study. Qualitative data was collected using semi-structured interviews and teacher lesson plans. Findings indicate that teachers need a proper intervention that can assist teachers to improve their lesson planning as they are relying on completing the templates from the Department of Basic Education. In the local context and culture, adapted lesson study showed to be useful as an intervention to assist teachers in developing lessons on photoelectric effect.

Sc2023_023_SP

THE COGNITIVE ACADEMIC LANGUAGE PROFICIENCY NEEDS OF ENGLISH SECOND LANGUAGE PRE-SERVICE AND IN-SERVICE NATURAL SCIENCES TEACHERS

O.K. Pila, L. Mavuru
University of Johannesburg

Presentation type: Short Paper
Subject Strand: Natural Sciences
Area Strand: Secondary Education

Teachers' Cognitive Academic Language Proficiency (CALP) is important for effective teaching and learning of science. English is the language of teaching and learning in most township schools though it is a second language for most teachers. Teachers may not be proficient in English; the current study sought to identify and compare the CALP needs of English second language pre-service and in-service Natural Sciences teachers with the research questions what are pre-service and in-service English second language teachers' CALP needs when teaching Natural Sciences? 2. How do the pre-service and in-service English second language teachers' CALP needs compare? Such a comparison informs the kind of development that each group can receive. Sociocultural theory framed the study. Through a quantitative research design data was collected from 100 purposefully selected pre- and in-service teachers and analysed using SPSS. No significant difference was found between the CALP needs of pre- and in-service teachers

Sc2023_024_SP

EFFECTIVENESS OF KENYA'S STRENGTHENING OF MATHEMATICS AND SCIENCE IN SECONDARY EDUCATION PROJECT ON STUDENTS' ATTITUDES AND BEHAVIOURS: A QUALITATIVE ANALYSIS FROM THE LONG-TERM PERSPECTIVE

M. Kosaka[1], N. Nakawa[2]
[1]University of Fukui, Japan, [2]Kanto Gakuin University, Japan

Presentation type: Short Paper
Subject Strand: Natural Sciences
Area Strand: Continuous Teacher Education

This study qualitatively assesses the effectiveness of the Strengthening of Mathematics and Science in Secondary Education (SMASSE) project from a long-term perspective. In collaboration with Kenyan research collaborators and based on the social learning theory by Bandula, the study adopted the life-story method and interviewed 35 former students. Data collected from the interviews were examined using qualitative research analysis software NVivo, and SCAT (Steps for Coding and Theorisation) analysis was used to identify respondents' experience as former SMASSE students. This analysis has identified long-term positive effects on various aspects of human resource development, specifically the impact on post-graduation career development, employment opportunities, and the resulting change in the attitudes and behaviour of Kenyan students. Overall, the study findings show a positive impact on former students' career choices and life contexts outside of science and confirm that these elements are mutually interrelated.

Sc2023_025_SN

DEVELOPING PHYSICAL SCIENCES' PEDAGOGICAL CONTENT KNOWLEDGE IN THE INTEGRATION OF EDUCATIONAL TECHNOLOGIES

M.C. Sincuba, S. Boateng, J.K. Alex
Walter Sisulu University

Presentation type: Snapshot Paper
Subject strand: Physical Sciences
Area strand: Continuous Professional Teacher Development

This study examines the impact of Gamma Tutor and Virtual ChemLab educational technologies on enabling pedagogical paradigm shifts among Physical Sciences teachers. It explores the pedagogical practices for the 21st-century classroom in the wake of the COVID-19 pandemic. This proposed study will be underpinned by two theoretical frameworks, namely, the Topic Specific Pedagogical Content Knowledge by Mavhunga (2012) and the Technological Pedagogical and Content Knowledge by Mishra and Koehler (2006). By adopting a pragmatic paradigm, a sequential mixed approach seems appropriate to explore aspects of lifelong learning and self-directed learning among teachers. Data will be generated from secondary schools that are participating in the Professional Learning Network being facilitated by the Govan Mbeki Mathematics Development Centre, Nelson Mandela University in partnership with Walter Sisulu University, and the Department of Roads. Purposive sampling is adopted to select twenty in-service Physical Sciences teachers from five senior secondary schools in OR Tambo Inland. Data will be collected using questionnaires, triangulated with focus group interviews, and class observation.

Sc2023_026_SP

THE DEVELOPMENT OF TEACHERS' PCK IN THE MEDIATION OF CHEMICAL EQUILIBRIUM: A FORMATIVE INTERVENTIONIST STUDY

Tasara Manamike, Prof Kenneth Ngcoza
Rhodes University

Presentation Type: Short Paper
Subject Strand: Science Chemistry
Area strand: Secondary Education

Chemical equilibrium is consistently identified by national examiners in Namibia as the main topic that students fail. Consequently, exploratory studies were conducted in Namibia on the teaching of chemical equilibrium and they revealed that teachers lack pedagogical content knowledge (PCK) for the topic. Accordingly, the researchers recommended continuing teacher professional development (CTPD). However, it seems that current CTPD practices are not effective because of epistemological contestations on chemical equilibrium and the neglect of the teachers' contexts by the facilitators. It is against this backdrop that we conducted this formative interventionist study to improve Grade 12 teachers' PCK for teaching chemical equilibrium. This qualitative case study, underpinned by a blend of the interpretivist and critical paradigm, was based on the cultural historical activity theory and topic specific-PCK. The qualitative data generated, and analysed inductively, revealed that a formative intervention enables participants to collectively learn something that does not yet exist.

Sc2023_027_SN

EXPLORING LECTURERS' TSPCK IN ELECTROCHEMISTRY

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Presentation Type: Snapshot Paper
Subject Strand: Science, Chemistry
Area Strand: Tertiary Education

Poor conceptual understanding and poor performance in the topic of electrochemistry has been a challenge for both secondary school and tertiary level. With much research focused on improving teaching of electrochemistry at school level, this study focuses on the tertiary level. This study aims to explore the topic specific pedagogical content knowledge (TSPCK) of university lecturers in the topic of electrochemistry. The emphasis will be on first, second-, and third-year electrochemistry. Enacted TSPCK will be explored at each of the three levels. Interviews and observations will be the main methods of data collection and will be analysed through coding and making themes.

Sc2023_028_SP

A HYBRID INITIATIVE TO DETERMINE HOW A LECTURER OF A LARGE, FIRST-YEAR BIOLOGY CLASS COULD ENGAGE TUTORS TO EFFICIENTLY GAIN INSIGHT INTO STUDENTS' UNDERSTANDING OF COURSE MATERIAL AND ACADEMIC CHALLENGES

Shalini Dukhan
University of the Witwatersrand

Presentation type: Short Paper
Subject strand: Biology
Area strand: Tertiary education

During the lockdown, while curriculum delivery received priority in 'saving' the academic year within higher education, and much effort went into moving content online, little has been offered in literature to understand how lecturers can connect with students emotionally within the virtual space. This study shows how the digital space can be used to establish a line of communication between the lecturer and students, and how, when resulting trust is nurtured, this allows a space for students to express any vulnerabilities, in the emotional and academic sense. Activities designed by the lecturer were provided weekly, online, over six weeks for a class of 522 first-year biology students. Students voluntarily responded and the lecturer provided follow-up to connect with students in a social space and provide support for their cognitive development. When lecturers create a space for belonging, students are more open to the communication of their cognitive needs.

Sc2023_030_SP

NATURAL SCIENCES TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE: A PROFESSIONAL DEVELOPMENT INTERVENTION ON ASTRONOMICAL CONCEPTS

David Sentsho, Washington Dudu & Judicial Sebatana
North-West University

Presentation type: Short Paper
Subject Strand: Science, Natural Science
Area Strand: Secondary Education

The purpose of this study was to explore how participating in a professional development intervention (PDI) on Astronomical Concepts impact the shift of Natural Sciences teachers' pedagogical content knowledge (PCK). The 'Interconnected Model of Teacher Professional Growth (IMTPG)' model underpins this study. This qualitative multiple case study was conducted in sub-district of one educational district of the North West province with two Natural Sciences teachers. Data was generated using semi-structured interviews, documents and micro-lesson observations. Data was analysed using interconnected model of teacher professional growth (IMTPG). Findings show that participants were able to effectively deliver and assess astronomical concepts after attending a professional development intervention. This study recommends administration of PDIs for astronomical concepts for successful teaching and learning of a Planet Earth and Beyond knowledge strand in the Grade 9 Natural Sciences subject.

Sc2023_031_SP

RELATIONSHIPS AMONG SCIENCE EXPERIENCES, SCIENCE IDENTITIES, AND NATURE OF SCIENCE: PERCEPTIONS OF NOVICE SCIENCE TEACHERS

Renée Schwartz, Emily Little, Robert Bennett
Georgia State University, USA

Presentation type: Short Paper
Subject Strand: Natural Sciences
Area Strand: Initial Teacher Preparation Education

This study explored connections between Nature of Science (NOS) understandings, science identities, and instructional practices among novice secondary science teachers with (1) little or no professional science experience; or (2) extensive professional science experience. Professional science experiences included industry or academic scientific research. Participants were early career teachers in a master's level NOS course. Data included VNOS survey, course discussions, lesson plans, and interviews. All participants showed improved NOS understandings. Those with more professional science experience tended to identify as a scientist or as both scientist and science teacher. Those with less professional experience tended to identify as either a scientist or a science teacher. Only 50% of participants included explicit NOS in lesson plans, suggesting they struggled with the concept of "explicit/reflective." Results suggest differences between groups in NOS pedagogy.

Sc2023_032_SN

DEVELOPMENT AND ANALYSIS OF A GEOGRAPHICALLY DISTRIBUTED STEM TEACHER LEADER NETWORK

Allyson Rogan-Klyve, Brent Hancock, Emilie Hancock, Dr. Mark Oursland
Central Washington University, USA

Presentation type: Snapshot Paper Proposal
Subject Strand: Natural Science
Area Strand: Continuous Teacher Education

In this proposed snapshot presentation, an emerging research project that studies the development and impact of a network of geographically distributed STEM teacher leaders in a rural region of the United States will be described. The network aims to provide support and resources for isolated science and math teachers in rural communities to engage in action research projects to improve STEM learning in their local school or school district. Building on results from a previous project and findings from literature, the network framework emphasizes creating a STEM education ecosystem that focuses on project-based learning, culturally responsive pedagogies, and use of authentic assessments. Research on the network focuses on understanding the efficacy of the model in supporting and developing STEM teacher leaders as well as the impacts the network has on promoting educational change in teacher leaders' schools and districts.

Sc2023_033_SP

ENRICHING LEARNING OF WAVES AND SOUND THROUGH MOBILISING INDIGENOUS PRACTICES AND KNOWLEDGE ABOUT THE SEA

Xolani J. Mayana; Kenneth M. Ngcoza and Joyce Sewry
Rhodes University

Presentation Type: Short Paper
Subject strand: Physics
Area strand: Secondary school

Lack of interest and hence the decline in the number of learners doing science in schools is attributed in part to the decontextualised ways in which science is taught. It is against this backdrop that this study sought to investigate indigenous practices and knowledge in the community that can be integrated into the topic of waves and sound. A qualitative case study approach informed by Vygotsky's sociocultural theory was employed. Eighteen Grade 10 learners and two community elders voluntarily participated in this study. Data were generated from learners' discussions and presentations, observations and reflections. Data sets were analysed inductively. The findings of the study revealed that learners were actively involved during the discussions and their conceptions and dispositions were positively influenced by integrating IK into the topic of waves and sound. This suggests that there is a need for science teachers to consider learners' sociocultural backgrounds during their science teaching.

Sc2023_036_SP

IMPARTING THE IK ON MEDICINAL PLANTS FROM TRADITIONAL HEALERS INTO THE HIGH SCHOOL CURRICULUM TO ENABLE LEARNERS TO MAKE MEANING OF SCIENCE

N Khoza, S Dukhan, P Ramalepe, and I Risenga
University of the Witwatersrand

Presentation type: Short Paper
Subject strand: Natural Science
Area strand: Secondary Education

This is a qualitative case study that sought to explore indigenous knowledge of medicinal plants by traditional healers in the rural communities of Nkomazi Local Municipality to gain insight into how this knowledge could be used to make teaching and learning of Natural Science more accessible within the secondary school classroom. Ethnobotanical data were collected using semi-structured questionnaires. Learners living within these communities would usually be exposed to these medicinal plants used as part of healing practices, therefore if these plants were brought into the Natural Science classrooms during teaching and learning, the learners could see how the formal knowledge taught in science classes is aligned with what they already know based on their cultural background. Studies are required to engage learners to reflect and be actively involved in biodiversity conservation such as medicinal plants through teaching as means of introducing and enabling access to the fields of Botany.

Sc2023_037_SP

A COMPARISON BETWEEN SECONDARY SCHOOL TEACHERS' AND STUDENTS' PERCEPTIONS OF ENACTED PEDAGOGICAL CONTENT KNOWLEDGE IN BIOLOGY

Thumah Mapulanga[1]*, Gilbert Nshogoza[2] & Ameyaw Yaw[3]
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[3]University of Education, Ghana

Presentation type: Short paper
Subject strand: Science, Biology
Area strand: Secondary education

Since pedagogical content knowledge (PCK) plays a significant role in the achievement of learning outcomes, this study compared the teachers' and students' perceptions of enacted PCK (ePCK) in biology using the quantitative survey design. The sample consisted of 54 biology teachers and 319 students from 14 and 6 secondary schools respectively. The data were collected using Likert-type questionnaires and analysed by computing means, standard deviations, and t-tests using the SPSS. The findings revealed that teachers' perceived ePCK was high while students' perceptions were moderate; there was a significant difference between teachers' and students' perceptions of ePCK; and the component 'what makes the subject easy/difficult to understand' was the least enacted component. The study recommends the inclusion of students. Further research should include a larger sample and behavioral measures of ePCK.

Sc2023_038_SP

PHYSICAL SCIENCE PRESERVICE TEACHERS' EXPERIENCES OF USING ENGLISH AS A MEDIUM OF INSTRUCTION DURING TEACHING PRACTICE

M. Qhobela
National University of Lesotho

Presentation type: Short paper
Subject strand: Science, Physics
Area strand: Secondary education

This paper documents experiences of physical science pre-service teachers during teaching practice (TP) in relation to use of English as language of learning and teaching in the science classrooms. The paper sought to respond the research question; What are the experiences of PSTs about the use of English as a language of learning and teaching of science during TP? Data analysed in this study came from sixteen physical science pre-service teachers who were completing BScEd programme. The findings of the study show that some PSTs opted for use of English while others chose to use both Sesotho and English. These choices were influenced by different considerations.

Sc2023_040_SP

HOW TO TEACH DIGITAL-TSPCK? A CASE WITH CHEMISTRY PRE-SERVICE TEACHERS

M.F. Zondi, E. Mavhunga
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Science, Chemistry
Area Strand: Initial Teacher Education – Pre-School teachers

The migration to digital teaching and learning platforms has been a game changer calling for a refinement of both the traditional-TSPCK construct and its delivery. This paper presents findings from a study that explored the effectiveness of two differently structured interventions for developing teacher knowledge for teaching science using a refined construct, digital-TSPCK. The study was a longitudinal study employing a qualitative research design with a cohort of Chemistry pre-service teachers (PSTs) as a case study over 2 years. Primary data were post-intervention PSTs' self-built teaching videos in chemical equilibrium collected in each year. The PSTs' reflections were also collected similarly in both years. The analysis followed an in-depth qualitative analysis for digital-TSPCK episodes by two raters. Content analysis was used to analyse the reflections for triangulation. Findings reveal differentiated scale of effectiveness across the two intervention approaches. Implications about digitized teacher knowledge are made.

Sc2023_042_SP

AN EXPLORATION OF FIRST-YEAR MEDICAL STUDENTS' CELL BIOLOGY PRIOR KNOWLEDGE AND ITS EFFECT ON SUBSEQUENT CONCEPTUAL UNDERSTANDING.

Letisha Lalbahadur, Kershree Padayachee and Shalini Dukhan
University of the Witwatersrand.

Presentation Type: Short Paper
Subject Strand: Science Biology
Area Strand**:** Tertiary Education

Medical students' prior knowledge of cell biology could provide insight on their subsequent conceptual development and understanding. To explore this possibility, four data sources were analysed, viz., the course outline provided to students, student participants' responses to cell biology questions in diagnostic and summative assessment, and interviews with lecturers. Responses to diagnostic tests on students' prior knowledge at the start of first year confirmed that the majority do not understand cell biology from high school. Consequently, students may be unable to assimilate successive knowledge. The study also revealed that first-year lecturers are only vaguely aware of the content that is taught in school. The findings highlight areas of cell biology where lack of understanding may pose challenges for first-year medical students, and areas where lecturers may need to provide greater scaffolding.

Sc2023_043_SN

INVESTIGATING THE ALIGNMENT IN COMPETENCIES DEVELOPMENT IN TEACHER TRAINING AND PRIMARY SCHOOL SCIENCE CURRICULUM

M. Phakisi
Lesotho College of Education

Presentation type: Snapshot Paper
Subject Strand: Natural Sciences
Area Strand: Primary Education

Lesotho should advocate for education that fosters students' development of life competencies. Competencies are set of demonstrable traits and skills needed in order to improve the efficiency in job performance. To achieve this, competence-based teaching and learning of science is crucial. Competence based teaching and learning is the form of education that emphasises on the development of life skills and mastery of the skills an individual will need to function effectively in a given society. So, teachers have to be equipped to use appropriate interactive teaching strategies. The paper sets out to find if the science curriculum in Lesotho primary teachers' training institutions, exhibits the need for the development of the competencies specified in the primary school curriculum. To answer this question, a document analysis of the primary science curriculum of the two institutions will be made. A sample of four (4) candidates will be interviewed.

Sc2023_047_SP

PRELIMINARY FINDINGS EMERGING FROM DEVELOPING A RUBRIC FOR MEASURING DIGITAL TSPCK IN TEACHING VIDEOS

O.S. Akinyemi, M. Mavhunga, M.F. Zondi
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Science Chemistry
Area Strand: Initial Teach Education – Pre-service teachers

The recent sudden move from traditional classroom settings to teaching and learning remotely has rendered Pedagogical Content Knowledge (PCK) and the associated TSPCK framework insufficient in developing competent science teachers to teach on digital platforms. In response to this challenge, the newly refined construct of digital-TSPCK interactively draws on TSPCK, cognitive theory of learning through multimedia and digital teaching competency in enabling pedagogical transformation of a given topic in digital formats like teaching videos. However, little is known about measuring the quality of d-TSPCK displayed in the teaching videos digitally created by teachers. Hence, this paper presents preliminary findings on the development and validation of a rubric for measuring the quality of d-TSPCK in purposefully created teaching videos for the topic of chemical equilibrium. The findings have implications for interventions targeting the development of digital teacher knowledge to be structured for effective science teaching.

Sc2023_048_SP

UNDERSTANDING HOW SECONDARY SCHOOLS IMPLEMENT GRADE 8 SCIENCE AND TECHNOLOGY INTEGRATED CURRICULUM

Sechaba Koma & 'Malefu C. Nthathakane
National University of Lesotho

Presentation type: Short Paper
Subject Strand: Natural Science
Area Strand: Secondary Education

The Integrated Curriculum in Lesotho requires that science teachers at the Grade 8 level teach seven traditional subjects. The study sought to investigate how secondary schools allocate these teachers to teach Science and Technology Integrated Curriculum (STIC) and how such allocations influence successes and challenges experienced in implementing the curriculum. The study adopted an interpretive methodology and was guided by the typology of curriculum representations. Eleven Heads of Science and Mathematics Departments were purposively sampled to complete an online open-ended questionnaire. The results show that schools either allocate a team of teachers according to their subject specialisations or just one teacher to teach all the components of STIC. These allocations result in partial implementation; some components are not taught, or the integrated nature of the curriculum is compromised. The findings suggest that curriculum documents should be explicit about how teachers are allocated to STIC for successful implementation.

Sc2023_049_SP

NATURAL SCIENCES TEACHERS' VIEWS ON INDIGENOUS KNOWLEDGE AND HOW TO USE IT IN TEACHING AND LEARNING IN SOUTH AFRICAN CLASSROOM

Nimrod Paseka Raphothe
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Natural Sciences
Area Strand: Secondary Education

This study examines the grades 8 and 9 Natural Sciences teachers' views on what Indigenous Knowledge (IK) is, views on what the curriculum assessment and policy statement (CAPS) mandates and ways in which IK could be integrated in their teaching and learning of Natural Sciences. Data were collected using questionnaires and followed up with semi-structured interviews. The study took a qualitative case study approach and used Aikenhead and Jegede's border crossing, Vygotsky's Social constructivism, specifically the More Knowledgeable Other (MKO) and Zone of Proximal Development (ZPD), and Piaget's Cognitive constructivism as the lens. Thematic content analysis was used to analyse data. Findings indicated that there is a misalignment between the different curriculum documents used by teachers with regards to IK. Despite the misalignment teachers are integrating IK into their teaching, as mandated by the CAPS document.

Sc2023_052_SN

EXPLORING STUDENTS' PERCEPTIONS AND OPPORTUNITIES FOR CURRICULUM REFORM IN AN ACADEMIC DEVELOPMENT PROGRAMME CHEMISTRY MODULE

Tisetso Mosala, Kgadi Mathabathe, Rethabile Tekane
University of Pretoria

Presentation type: Snapshot Paper
Subject Strand: Science Chemistry
Area Strand: Tertiary Education

Engineering students aspiring to major in chemical engineering are required to enroll in a pre-requisite general chemistry course offered in the second semester of their first year. Although students are exposed to various learning supports to assist them to develop a better understanding of the course, the pass rates have, in the past five years, been lower than the target pass rates for the University. This study aims to evaluate the chemistry course by taking into consideration students' perceptions and lecturers' views of the course. A qualitative research approach will be followed, in which open-ended questionnaires and interviews are used. We expect that the findings will expose the aspects of the course that are perceived as making it difficult for the students to understand the course, and contribute towards a revamp of the course which takes into account the students' perceptions and lecturers' views.

Sc2023_053_PO

CROSSING THE RIVER: DIFFERENT LEARNER PERSPECTIVES ON THE INTEGRATION OF INDIGENOUS KNOWLEDGE IN SCIENCE

Lindiwe P. Godlo, Kenneth M. Ngcoza, Chrispen Mutanho
Rhodes University

Presentation type: Short Paper
Subject Strand: Natural Science
Area Strand: Primary Education

Learners seem to experience cognitive dissonance on the topic of the conservation of heat energy. It is against this backdrop that this study aimed to explore learners' views on the integration of indigenous knowledge (IK) in this topic. Underpinned by the interpretivist and indigenous research paradigms, a qualitative case study design was employed. Five learners voluntarily participated in this study. Data were generated using document analysis and focus group interviews. Vygotsky's sociocultural theory and Ogunniyi's Contiguity Argumentative Theory were used as theoretical lenses to analyse data. The findings revealed that there is little information on the integration of IK in science curriculum documents. Moreover, the use of language foreign to learners and making use of examples unfamiliar to their contexts do not motivate them to learn science. We thus recommend that learners be allowed to voice their views on what IK they want to learn.

Sc2023_054_SP

INCLUSION OF SOUTH AFRICA'S INDIGENOUS KNOWLEDGE BIOPROSPECTING ASPECTS INTO THE SECONDARY SCHOOL CURRICULUM: THE CASE OF LIPPIA JAVANICA

Khombomoni Keith Chuma, Shalini Dukhan, Ida Risenga
University of the Witwatersrand

Presentation type: Short Paper
Subject strand: Natural Science
Area strand: Secondary Education

The National Curriculum Assessment Policy Statements (CAPS) aims to show the value of Indigenous Knowledge Systems (IKS) and acknowledge the rich history and heritage of South Africa as essential contributors to nurturing the values contained in the Constitution. The study aimed to assess whether the South African permit system protects Indigenous Knowledge (IK) and its holders. The study employed a case-study approach, and data were collected through questionnaires, document analysis, and semi-structured interviews. Data were analyzed using thematic analysis. The study's main findings indicated that the permit system fell short of achieving its intended purpose of protecting IK holders and their knowledge. IK holders felt isolated in this process and used their knowledge without benefitting their community. Studies and findings such as this can be included when teaching secondary school learners, the need to value and acknowledge their African IK, as mandated by CAPS.

Sc2023_055_SP

THE DEVELOPMENT OF AN OUT-OF-FIELD TEACHER'S PEDAGOGICAL REASONING WHILE SOLVING A TWO-BODY PROBLEM IN MECHANICS

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Presentation type: Short Paper
Subject Strand: Science Physics
Area Strand Secondary Education

Problems involving Newtons laws of motion are well known for the challenge they present for both teachers and learners. They present an even greater challenge for out of field physical teachers who may be well versed in chemistry, rather than physics. This paper describes how a retired chemistry professor tackled the solution of a problem on Newton's laws of motion to teach a group of grade 12 students. The aim of the study was to illuminate the strategies used by the teacher to solve the problem, the teaching strategies that unfolded, and the pedagogical reasoning involved in the process of developing the strategies employed. The findings revealed shortcomings in her content knowledge and her handling of the conceptual challenges associated with the problem. Reflections such as these are useful to other teachers as they may help them rethink their own approaches to teaching, identify the shortcomings in their own content knowledge possibly led them to interrogate and improve it.

Sc2023_056_SN

INTEGRATING COMMUNITY CULTURAL HERITAGE IN THE TEACHING OF THE GRADE 10 PHYSICAL SCIENCES TOPIC 'CLASSIFICATION OF MATTER' IN GAUTENG SCHOOLS.

Tarisai Mudzatsi
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Presentation type: Snapshot Paper
Subject strand: Science Chemistry
Area strand: Secondary Education

The cultural practices of marginalised groups have largely been omitted in the teaching of school science, moreover, there is little evidence in the curriculum or in the texts used in schools to what is a rich resource of knowledge. This has resulted in a debate in the scholarly community about issues around cultural deprivation and decoloniality not only in South African public schools but also in science education. According to Shava and Nkompodi (2017), "The academic landscape in higher education institutions (universities in the Southern African Development Community or SADC region) remains highly influenced by western epistemologies" (p. 80). The proposed study regards community cultural heritage perspectives as a means through which cultural deprivation and marginalisation of indigenous knowledge can be addressed in classrooms of Physical sciences so that the science taught in classrooms is inherently related, coherent, and relevant to the practices of the community.

Sc2023_057_SN

SCIENCE TEACHERS' AWARENESS OF THE INCLUSION OF IK IN THE SOUTH AFRICAN EDUCATIONAL POLICY

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Presentation type: Snapshot Paper
Subject Strand: Science Biology
Area Strand: Secondary Education

Science educators in South Africa have focused on the need to achieve the aim of the curriculum by making Science education accessible to all learners. This study explores teachers' awareness of the mandate to integrate Indigenous Knowledge (IK) in their Science classroom. Two research questions were posed: What does the curriculum state regarding the inclusion of IK in the Science classroom? What awareness do teachers have of the mandate to integrate IK in their life Sciences classroom? A qualitative case study research approach was adopted for this study. A purposive sampling strategy was adopted and 8 Grades 10 and 11 Life Sciences teachers in three peri-urban high schools in South Africa were involved in this study. Findings revealed that 50% of the participants were not aware of the mandate to integrate IK with Sciences, while 50% of the participants were aware of the mandated stated in the policy for integration.

Sc2023_058_SN

THE DEVELOPMENT OF SCIENCE IDENTITY AMONG SCIENCE UNDERGRADUATES AT A SOUTH AFRICAN UNIVERSITY

Flavia Kigozi, Shalini Dukhan, Ida Risenga
University of the Witwatersrand

Presentation type: Snapshot Paper
Subject strand: Science Biology
Area strand: Tertiary Education

The Department of Higher Education in South Africa seeks to increase the number of sciences, technology, engineering, and mathematics (STEM) graduates from universities. However, this increased enrolment has not been matched by a proportionate growth in graduate output in science fields. This study will examine the influence of self-recognition and recognition from others on the development of biological science identity for undergraduate students and the extent to which the development of science identity influences aspirations to continue within the field of biological sciences when they enter employment. A mixed method approach using a questionnaire and semi-structured interviews will be used to collect data. Afterwards, students will be invited to participate in a two-part semi-structured interview. Data will be analysed using SPSS and MAXQDA.

Sc2023_059_SP

EXAMINING THE PRESENTATION OF ELECTROSTATICS IN SELECTED PHYSICAL SCIENCES TEXTBOOKS USING THE PEDAGOGICAL CONTENT KNOWLEDGE CONSTRUCT

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Presentation type: Short Paper
Subject strand: Science Physics
Area strand: Tertiary Education

Curriculum statements are crucial documents for guiding teaching and learning as the sources of information about the content and skills to be acquired by learners. Textbooks translate curriculum statements into materials to be used in schools. The present paper examines the presentation of electrostatics in three prescribed physical sciences textbooks for direct evidence of pedagogical content knowledge (PCK). PCK describes the transformation of topic specific content into teachable forms and its evidence in the textbooks would indicate their effectiveness. A theoretical framework for conceptualizing the role and place of textbooks in teachers' knowledge and practice has been developed for this study. Furthermore, the components of the grand PCK rubric served as the analytical lenses for studying the evidence of PCK in the textbooks. The components are knowledge and skills related to (i) curricular saliency, (ii) learners' understanding of concepts, (iii) representations, and (iv) conceptual teaching strategies. The textbooks were analysed using in-depth content analysis in a deductive approach guided by literature in the components of PCK in terms of electrostatics. The results indicated that curricular saliency was sufficiently presented in the textbooks compared to the other components. The results recommend a detailed inclusion of representations and a presentation of concepts that pay attention to areas that are challenging for

learners. Furthermore, textbook users need to involve other materials to supplement them where they fall short.

Sc2023_060_PO

MOBILISING STORIES ABOUT CULTURAL BELIEFS AND PRACTICES ON TRADITIONAL FOODS TO CONTEXTUALISE THE TOPIC OF NUTRITION IN A GRADE 6 TOWNSHIP CLASS

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Presentation type: Poster Paper
Subject Strand: Natural Science
Area Strand: Primary Education

The Curriculum and Assessment Policy Statement (CAPS) document is silent on how science teachers should integrate Indigenous knowledge in their classrooms. This contradiction triggered our interest to investigate the effect of mobilising stories on cultural beliefs and practices about traditional foods when mediating learning on the topic of nutrition in a Grade 6 township class. The study was underpinned by an indigenous research paradigm within which an Ubuntu perspective was used. We adopted a qualitative case study research design and it was conducted at Mdoko Primary School [pseudonym] in a semi-urban community of the Amathole West Education District. The participants were 34 learners, two expert community members and a critical friend. We used participatory observations and journal reflections to generate data. Vygotsky's Sociocultural Theory and Ogunniyi's Contiguity Argumentation Theory were used as theoretical lenses. The findings revealed that learners' social interactions and argumentation were enhanced during presentations by expert community members.

Sc2023_061_SN

CHEMICAL SAFETY AND SECURITY EDUCATION: LABORATORY PERSONNEL'S VIEWS

Francinah Futhane, Rethabile Tekane
University of Pretoria

Presentation type: Snapshot Paper
Subject Strand: Science Chemistry
Area Strand: Tertiary Education

Although both chemical safety and security fall under chemical risk management, research has shown that knowledge about chemical safety is more prevalent at post-secondary institutions than chemical security. Knowledge about chemical safety and security is important because chemical safety protects students and workers from chemicals, whereas chemical security prevents the misuse of chemicals. Therefore, this qualitative study aims to learn more about laboratory personnel's knowledge and understanding of chemical safety and security education. Open-ended questionnaires and interviews will be used to address the aim. Thematic analysis will be used for analysing data. Training of laboratory staff focuses heavily on chemical safety. Educating staff responsible for laboratories about chemical security will inform good practices in terms of storage and disposal of

chemicals. Training focusing on chemical security is envisaged as a possible outcome of such as study.

Sc2023_062_SN

EXPLORING THE NATURE OF STUDENT INTERACTION IN COLLABORATIVE CONCEPT MAPPING: A CASE OF LIFE SCIENCES PRE-SERVICE TEACHERS

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Presentation type: Snapshot Paper
Subject Strand: Science Biology
Area Strand: Initial Teacher Education

The use of concept maps in science classrooms has long been advocated for. In particular, collaborative concept maps are given priority as students can interact with one another. The focus of this study is on investigating the nature of interactions that take place between in each pair of students during the construction of concept maps. The goal is to understand how these interactions contribute to the improvement of these concept maps.

Sc2023_063_SP

THE OPPORTUNITIES AND CHALLENGES OF USING A SELF-STUDY APPROACH AS A STRATEGY FOR PROFESSIONAL DEVELOPMENT: THE CASE OF EVOLUTIONARY GENETICS TEACHING

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Presentation type: Short Paper
Subject Strand: Science Biology
Area Strand: Secondary Education

This inquiry sought to investigate the potential opportunities and challenges of using a self-study approach as a strategy for professional development during my teaching of evolutionary genetics to 24 twelfth grade students. I had always struggled to address misconceptions, motivate my students to accept, and to understand the topic of evolutionary genetics. Vygotsky's social constructivism of knowledge, Shulman's pedagogical action, and reasoning models were the theoretical lenses that guided this inquiry. Collected data included pre and post-test data, lesson transcripts, my reflections, and notes on collaborative activities with others. The collected data was analysed both quantitatively and qualitatively through deductive and inductive data analysis. This study established that whilst opening up for feedback and making one's pedagogical actions and reasoning public makes one 'vulnerable' and exposed to 'attack' by others, it offers unlimited professional growth opportunities beyond one's personal biases, interpretations, and teacher training expertise. The 'negative' and positive critiques from others are powerful critical reflection points for enhancing professional development.

Sc2023_067_SP

AN EXPLORATION OF HOW OPPORTUNITIES FOR LEARNING ARE CREATED IN BIOLOGY TEACHER EDUCATION CLASSROOMS: A CASE OF FOUR TEACHER EDUCATORS

Naomi Thomas & Eunice Nyamupangedengu
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Science Biology
Area Strand: Tertiary Education

Little is known about how teacher educators create learning opportunities during the teaching of life sciences to pre-service teachers. This study explored how teacher educators create opportunities for preservice teachers to learn. The study employed a qualitative approach with an interpretive worldview. The design of the study was a multiple case study of four teacher educators with their preservice teachers. The participants were selected based on their willingness to participate in the study. Data collected was in the form of lecture video recordings and interviews. Data analysis was both deductive and inductive. Results of the analysis suggest that all educators created opportunities with the first five categories occurring across cases and some variation from categories six to eighteen categories. The study aims to contribute to a better understanding of opportunities that can be created in the lectures of teacher educators.

Sc2023_068_SP

AN INVESTIGATION OF HIGH SCHOOL STUDENTS' CONCEPTUAL UNDERSTANDING OF GEOMETRIC OPTICS

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Presentation type: Short Paper
Subject Strand: Science Physics
Area Strand: Secondary Education

This study investigates conceptual understanding of geometric optics amongst physics students in Uganda. It made use of Four-tier Geometrical Optics Test (FTGOT), a standardized assessment adapted from PHYSPORT. FTGOT, enabled us to do quantitative assessment of students' response question items. Quantitative analysis of the senior six students' responses to FTGOT was taken beyond the conventional responses of assessing the correct options given, by examining the distribution of the multiple choices using concentration analysis which sought to discover how effective questions are in seeking conceptual knowledge and the possible patterns of the distribution of their options. Interpretive qualitative analysis of students' responses to interview questions in a focus group discussion was also used to corroborate the findings. The study showed that students have several alternative conceptions and few scientific conceptions. The Implications of the study and recommendation for further studies were made for stakeholders in science education.

Sc2023_069_SP

EXPLORING BIOLOGY TEACHERS' SUBJECT MATTER KNOWLEDGE IN GENETIC ENGINEERING; A CASE OF THREE HIGH SCHOOL TEACHERS

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[1]Ministry of Education and Training, Lesotho, [2]National University of Lesotho

Presentation type: Short Paper
Subject Strand: Science Biology
Area Strand: Secondary Education

Subject matter knowledge is considered a very important aspect of teacher knowledge necessary to promote acquisition of scientifically accurate knowledge. However, literature on this matter is scarce in the context of Lesotho. Hence this paper focused on three high school teachers' subject matter knowledge in genetic engineering. The study employed a qualitative methodology using a case study design. The participants were conveniently selected. Data were collected using a questionnaire. The findings revealed some discrepancies in the teachers' knowledge of genetic engineering and their knowledge of learners' common misconceptions. Recommendations made include strengthening pre-service and in-service teacher programmes to enhance SMK regarding genetic engineering.

Sc2023_070_SP

EXPLORING OPPORTUNITIES TO LEARN AS EXPERIENCED CURRICULUM IN SELECTED SCIENCE TEACHER EDUCATION PROGRAMMES IN SOUTH AFRICA

DM Letloenyane
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Presentation type: Short Paper
Subject Strand: Natural Sciences
Area Strand: Initial Teacher Education

Teacher education curricula have been the subject of numerous investigations because amongst others, it seeks to ensure that physical sciences teachers are trained in an effective and systematic manner. Although studies have investigated physical sciences teacher education curricula using national and institutional policies and frameworks, few studies have explored the curriculum as lived experiences of physical sciences pre-service teachers. This quantitative study uses a questionnaire to collect data from 112 respondents in four universities. The findings reveal that pre-service teachers are afforded more opportunities to learn school-level physical sciences than tertiary level science although the school-level physical sciences at universities is pitched at a more conceptual level than what the school curriculum offers. The findings also show that pre-service teachers are occasionally afforded the opportunities to learn science pedagogy and education although the level of emphasis of topics differs.

Sc2023_071_SP

INVESTIGATING PRE-SERVICE TEACHERS' VIEWS ABOUT HOW THEIR CHOSEN REPRESENTATIONS CAN EFFECTIVELY DEVELOP SCIENTIFIC CONCEPTS: A CASE OF TWO PHYSICS PRE-SERVICE TEACHERS.

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National University of Lesotho

Presentation type: Short Paper
Subject strand: Science, Physics
Area strand: Secondary Education

This study investigated PSTs' views about the effectiveness of their suggested representations towards the learning of scientific concepts. It responds to the research question; how do PSTs think their suggested representations will enhance the learning of the scientific concepts? Two physics PSTs responded to the CoRe prompts that enable them to describe representations they can use to effectively teach a specific topic. Following the initial analysis of the CoRe responses the PSTs were interviewed. Content analysis was followed to make meaning of the suggested representations. The findings show that PSTs thought that their suggested representations will assist students to visualise abstract and difficult scientific concepts. The study recommends that teacher training institutions must develop PSTs' knowledge and competence in the use of multiple representations.

Sc2023_074 _SN

EXPLORING THE EFFECT OF AN INTERVENTION ON NAMIBIAN BIOLOGY TEACHERS' PROCEDURAL KNOWLEDGE OF SCIENTIFIC INQUIRY

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Presentation type: Snapshot Paper
Subject Strand: Science Biology
Area Strand: Secondary Education

In science education, various instructional models including the predict-explain-explore-observe-explain (PEEOE) have been designed and used to support scientific inquiry. However, the models do not include some of the vital procedures of scientific inquiry. This study aims to explore how one of the models can be strengthened to include these procedures of inquiry. This qualitative case study targets six Biology teachers. Qualitative data will be generated. The revised Shulman's Pedagogical Content Knowledge (PCK) theory, particularly Topic-Specific Pedagogical Knowledge will be used as the theoretical and analytical framework. It is expected that data from this study will reveal whether the suggested model will help to develop the PEEOE approach into a suitable procedural model for scientific inquiry. It is further expected that the analysis of data will show the effect of the intervention, if any, on the teachers' PCK.

Sc2023_075_SN

THE USE OF CHIRALITY-2 APP IN A FIRST YEAR ORGANIC CHEMISTRY CLASS: IMPACT ON STUDENT LEARNING AND UNDERSTANDING

Rethabile Tekane
University of Pretoria

Presentation type: Snapshot Paper
Subject Strand: Science Chemistry
Area Strand: Tertiary Education

The use of mobile applications as teaching and learning tools has rapidly increased in the past decade. Few chemistry-related mobile applications have been used as teaching and learning tools in chemistry, specifically in organic chemistry. To date, Chairs! and Chirality-2 are the only gaming applications used as teaching and learning tools in organic chemistry classrooms. Limited studies have been published on the evaluation of these mobile applications in organic chemistry classrooms. To date, there are no studies published on the evaluation of these mobile apps in organic chemistry classrooms in a South African context. Therefore, this study aims to evaluate the impact of the Chirality-2 mobile gaming app on students' learning and understanding of organic chemistry.

Sc2023_077_SN

ASSESSING PRE-SERVICE SCIENCE TEACHERS' ACADEMIC KNOWLEDGE AND MISCONCEPTIONS ABOUT EVOLUTION AND GENETICS

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Presentation type: Snapshot Paper
Subject Strand: Science Biology
Area Strand: Initial Teacher Education

Studies suggest that students hold misconceptions in biological concepts such as genetics and evolution. These misconceptions impede students' ability to understand proper scientific explanations which constitute major obstacles to learning evolution and genetics concepts. This study aims to assess pre-service science teachers' academic knowledge and misconceptions about evolution and genetics. This study is influenced by the essentialist view of thinking. A mixed methods research design was employed for a sample of 200 pre-service science teachers. Data was collected using TEGIC and interviews. Data analysis will be performed using independent sample t-test, ANOVA, and thematic content analysis. The study will make recommends for alternative methods in developing educational resources in evolution and genetics to assist lecturers and teachers to teach the concepts effectively for students' retention.

Sc2023_078_SP

SUPPORTING TEACHERS' INTEGRATION OF DIVERSE INDIGENOUS KNOWLEDGE IN MULTICULTURAL CLASSROOMS

Chrispen Mutanho and Kenneth M. Ngcoza
Rhodes University

Presentation type: Short Paper
Subject Strand: Natural Science
Area Strand: Secondary Education

Post-apartheid South Africa has been characterised by several curriculum changes aimed at improving the quality of education and redressing the imbalances of the colonial era. One such change is the integration of IK in science education. However, such changes have often failed to yield the intended outcomes because teachers have not been properly trained on how to integrate IK. It is against this background that a qualitative case study informed by the sociocultural theory was conducted to explore how to support BEd Natural Sciences in-service teachers to integrate diverse indigenous knowledge in a multicultural classroom. The study revealed that integrating diverse indigenous knowledge generates interest among learners as it creates a rich learning environment from which students learn about scientific phenomena from different perspectives. The participants in this study were excited to see the similarities and differences between the processes of making umqombothi and oshikundu.

Sc2023_079_PO

FARM SCHOOL LEARNERS' VOICES COUNT: LEARNERS' VIEWS ON THE INTEGRATION OF IK IN THE TOPIC OF SOUND AND MOVEMENT

Hlengiwe Tshitshi, Kenneth M. Ngcoza, Chrispen Mutanho
Rhodes University

Presentation type: Short Paper
Subject Strand: Natural Science
Area Strand: Primary Education

The current version of the science programme for grades 4–9 encourages teachers to integrate indigenous knowledge (IK) into their teaching. However, IK is hardly discussed in the curriculum and there are no guidelines on how to integrate it. It is against this background that in this study we sought to explore Grade 4 learners' attitudes towards learning science and their views on the integration of IK in the topic of sound and movement using traditional musical instruments. A qualitative case study research design was employed underpinned by the interpretive and indigenous research paradigms. Data were gathered using document analysis and focus group interviews. Vygotsky's sociocultural theory and Ogunniyi's Contiguity Argumentative Theory were used as theoretical lenses. The findings revealed that integrating learners' IK into science learning motivates them to learn science. The study recommends that there is a need for learning and teaching materials that integrate IK.

Sc2023_080_SP

EXPLORING RELEVANT PRIOR CONTENT KNOWLEDGE THAT GRADE 12 PHYSICAL SCIENCES LEARNERS HAVE BEFORE LEARNING THE WORK-ENERGY THEOREM

Alfred Mapfumo and Kenneth M. Ngcoza
Rhodes University

Presentation type: Short Paper
Subject Strand: Physical Science
Area Strand: Senior Secondary

Prior knowledge is the basis for the construction of new knowledge. This paper reports on a qualitative case study that was conducted to explore the prior content knowledge relevant to learning the work and energy concepts with a particular focus on the work-energy theorem. Energy is a critical concept in physics problem-solving but is often a significant source of confusion for learners. Data were collected using a diagnostic test administered to a class of 37 Grade 12 learners in a particular rural high school in the Eastern Cape province of South Africa. In addition, stimulated recall interviews were conducted with some of the learners after the test had been marked. The findings showed that learners lacked prior knowledge of some of the concepts and skills that needed to be mastered before successfully learning the work-energy theorem and its application to problem-solving. Furthermore, learners confused concepts such as force, energy and power.

Sc2023_081_SP

EXAMINING THE TECHNICAL SCIENCES CONTENT IN LINE WITH BLOOM'S REVISED TAXONOMY OF EDUCATIONAL OBJECTIVES

Mabel Julia Mabalane
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Presentation type: Short Paper
Subject Strand: Technical Science
Area Strand: Secondary Education

The study evaluated the quality of the Technical Science curriculum to find reasons behind high performance in matric results (DBE, NSC Results). The margin of performance between Technical Science and other Science, Technology, Engineering and Mathematics (STEM) subjects such as Technical Mathematics, was relatively high and significantly different. In the study, high performance of matric results was linked to the quality of the curriculum, and the correlation between cognitive levels of Bloom's taxonomy and the curriculum objectives was unpacked and examined. Document analysis was done to qualitatively examine the content and the quality of the curriculum, and the findings revealed that the cognitive levels in the curriculum were unbalanced. The recommendation needed to enlighten the Technical Sciences curriculum developers to balance the cognitive level such that they meet the standards and quality of STEM education subjects.

Sc223_082_SP

UNDERSTANDING HOW TO TEACH CLIMATE CHANGE IN THE SENIOR PHASE BY IN-SERVICE NATURAL SCIENCES TEACHERS

B. Mzilikazi
University of Fort Hare

Presentation type: Short Paper
Subject Strand: Natural Science
Area Strand: Tertiary Education

The devastating effects of climate change on the environment have been a concern for governments all over the world, despite efforts to include climate change in the school curriculum being hindered by inefficient teaching pedagogies that encourage the successful delivery of the content area. To ascertain their knowledge of climate change in the natural sciences, semi-structured interviews with four out of twenty natural science teachers in the Amathole West district who have received pedagogical content knowledge training in teaching natural sciences have been undertaken. Findings reveal that teachers are struggling to integrate climate change into natural sciences teaching.

Sc2023_083_PO

CENTRING LEARNERS IN THE SCIENCE CURRICULUM: LEARNERS' DISPOSITIONS AND VIEWS ON THE INTEGRATION OF IK IN THE TOPIC OF ELECTROSTATICS

Lindiso Funani, Kenneth M. Ngcoza, Chrispen Mutanho
Rhodes University

Presentation type: Short Paper
Subject Strand: Natural Science
Area Strand: Primary Education

Although the Curriculum and Assessment Policy Statement (CAPS) document claims that it embraces local indigenous knowledge (IK) it does not specify how this should be done in schools. As a result, little or no integration of IK is enacted in many of our township schools. It is against this background that in this study we sought to explore Grade 7 learners' attitudes towards learning science and their views on the integration of IK in the topic of electrostatics focusing on lightning in particular. A qualitative case study was employed and was underpinned by the interpretive and indigenous paradigms. Eight Grade 7 learners voluntarily participated in focus group interviews (sharing circles) and this was complemented with document analysis. Vygotsky's sociocultural theory and Ogunniyi's Contiguity Argumentation Theory (CAT) were used as theoretical lenses. The findings revealed that learners were in favour of IK being integrated into their science lessons.

Sc2023_084_PO

CLIMBING A MOUNTAIN: LEARNERS' VIEWS ON THE INTEGRATION OF INDIGENOUS KNOWLEDGE IN THE TOPIC OF FOOD PROCESSING

Nomvume Tyeda, Kenneth M. Ngcoza, Chrispen Mutanho
Rhodes University

Presentation type: Short Paper
Subject Strand: Natural Science
Area Strand: Primary Education

The Curriculum Assessment and Policy Statement emphasize that IK should be integrated into science classrooms to redress the imbalances of the past. Yet, it seems to be silent about learners' views on the integration of IK in science classrooms. Based on this background, this study aimed at exploring learners' attitudes towards learning science and their views on the integration of IK in the topic of food processing. The data from the interviews were augmented with documentary evidence. Underpinned by the interpretive and indigenous research paradigms, a qualitative case study was adopted. Data were generated using document analysis and focus group interviews. Vygotsky's sociocultural theory complemented Ogunniyi's Contiguity Argumentation Theory (CAT) were used as the theoretical framework. The findings revealed that the CAPS seems to be silent about the integration of IK. Learners' interviews revealed that they are interested in IK. The study recommends that teachers need to acquaint themselves with curriculum documents.

Sc2023_086_SP

EXPLORING LIFE SCIENCES PRE-SERVICE TEACHERS' PEDAGOGICAL REASONING BEHIND THE CHOICE OF VIDEOS THEY USED DURING A MICROTEACHING ACTIVITY: A CASE STUDY AT A SOUTH AFRICAN UNIVERSITY

E Nyamupangedengu; E J Ajayi
University of the Witwatersrand

Presentation type: Short Paper
Subject Strand: Biology
Area Strand: Initial Teacher Education

Our experiences with pre-service teachers during teaching experience practicals show that YouTube videos are now a major teaching and learning aid in science classrooms. This observation motivated this study in which we investigated pre-service teachers' pedagogical reasoning behind the choice of videos that they used during microteaching activities. The pedagogical reasoning cycle and the TSPCK construct were used as theoretical frameworks. As qualitative research, we made use of a case-study approach which involved 60 pre-service Life Sciences teachers in a six-week methodology module. Data collected comprised filled-in micro-teaching observation rubrics, lesson plans and video-clips. Data analysis involved checking through rubrics one item at a time, grouping and quantifying similar entries. Lesson plans were deductively analysed guided by the two frameworks. Thus far, the students' pedagogical reasoning is showing a consideration of the components of both the pedagogical reasoning cycle as well as TSPCK. These insights will be discussed.

TECHNOLOGY – LONG PAPERS

T2023_012_LP

POLICY AND PRACTICE FOR SUSTAINABLE PRAXIS IN INFORMATION AND COMMUNICATION TECHNOLOGIES EDUCATION: A CASE STUDY ON RURAL CHALLENGES

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University of South Africa[2]

The purpose of the study reported on in this paper was to explore research questions on the extent to which the current infrastructure landscape at a particular rural primary school is sufficient for e-school initiatives and address the challenges faced by this school towards implementing e-school initiatives. It starts by providing some background on the research problem, with importance justified regarding the policy position of the South African national Department of (Basic) Education with regard to e-learning. After the literature review, it explains how data was generated from a case study and provides the key findings of the research conducted at the school, as well as discussing these results and study limitations in answer to the research questions in the conclusion. The paper thus covers intersecting policy and practice for sustainable praxis in Information and Communication Technologies (ICTs) education and provides future research directions towards the post-COVID-19 pandemic era.

T2023_003b_LP

FOSTERING CLASSROOM USE OF ICT AMONG PRE-SERVICE SCIENCE TEACHERS THROUGH TPACK

Edgar Sintema
University of the Free State

This study's aim was to compare PSTs' knowledge of integrating ICT resources into science instruction during their teaching practice based on country of their training, and to determine a linear combination of subfactors that best explains their ICT knowledge. Data were collected from 524 final year PSTs in three SADC countries: Lesotho, South Africa, and Zimbabwe. Stepwise linear regression was also run to find a linear combination of subfactors that significantly influenced their ability to integrate ICTs into their instruction. Based on results of the ANOVA test, PSTs' ICT competences significantly differed by country with Zimbabwean PST exhibiting higher confidence in their ICT competences than those from Lesotho and South Africa. It was also found that technological pedagogical knowledge (TPK) was the best predictor of PSTs' use of ICT in classrooms during teaching practice.

T2023_001_LP

INVESTIGATING TEACHER EDUCATORS' STRATEGIES FOR INTEGRATING TECHNOLOGY AND USING TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE IN TEACHING

Theodorio, A.O[1], Simuja Clement[2], Mataka Tawanda Wallace[3], and Brian Shambare[4]
ICT-in-Education Unit, Rhodes University[1,2,4] The National University of Lesotho[3]

The training of foundation phase teachers requires teacher educators to design instructions that will equip pre-service teachers with pedagogy and content knowledge. Mishra and Koehler's (2006) TPACK framework suggests that technology should be integrated into the instructional process to develop TPACK. However, one limitation of this framework is that it does not specify the strategy to use to integrate technology into teaching. This study aims to understand teacher educators' strategies for integrating technology into teaching and to explain the patterns of technological pedagogical content knowledge development. The participants in this study were selected using a purposive sampling technique. Data were collected through focus-group interviews and non-participant observation and analyzed inductively and thematically. The study's findings show that teacher educators made use of mind-mapping and rubrics; self-made Podcast Videos and diagrams; and self-reflection. However, it seems that teacher educators need an understanding of the development of the TPACK framework in teaching contexts.

TECHNOLOGY – SHORT PAPERS

T2023_002_SP

CHALLENGES AND OPPORTUNITIES IN OFFERING ROBOTICS TO SECONDARY LEARNERS IN LESOTHO: A CASE STUDY

Mokiti Janefeke[1], Sechaba Koma[2], Macheli Mofolo[3] & Lereko Mohafa[2]
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Presentation Type: Short Paper
Subject Strand: Technology Robotics & Coding
Area Strand: Secondary Education

Many countries are introducing Robotics in the education sector. Lesotho has not yet introduced it, except for a small LMSTA group. This study, therefore, explored challenges and opportunities in offering Robotics in Lesotho Secondary education. A qualitative case study was used in which three learners and one mentor responded to an open-ended questionnaire. These learners have participated in Robotics international competitions through the guidance of their mentor. Follow-up interviews were also used to seek clarity. A deductive content analysis approach was used to classify data under SWOT analysis framework constructs. The findings revealed opportunities such as international recognition, networking and collaboration. However, the country may face several challenges when including Robotics in basic education due to lack of resources and trained teachers in Robotics. The study recommends that stakeholders have to make efforts to support robotics education as another area of Lesotho's basic education curriculum with broad opportunities.

T2023_005_SP

THE STATE OF READINESS FOR THE IMPLEMENTATION OF CODING AND ROBOTICS IN A HIGH SCHOOL

T. Mafugu & K. Mosia
University of the Free State

Presentation type: Short paper
Subject strand: Robotics and coding education
Area strand: Secondary education

The study sought to explore how coding and robotics were implemented in a selected school in a district within one province of South Africa. The study employed a single case study design, employing Rogan and Grayson's (2003) framework of curriculum implementation. Three themes emerged in the study: induction of learners; training of educators; and continuous support, which includes the availability of resources. The learners were inducted through engagement in coding and robotics competitions. The time for teacher training was too short to enhance the acquisition of the required knowledge and skills. Implementation was hampered by inadequate resources. The study recommends the provision of sufficient resources such as laptops and data to ensure smooth implementation. New teachers with the necessary knowledge must be recruited. If we want to see success in implementing coding and robotics, the government needs to negotiate cheaper internet bundles for schools.

T2023_006_SP

BRINGING THE COMMUNITY BACK INTO THE NAMIBIAN EDUCATION SYSTEM

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Presentation Type: Short Paper
Subject Strand: Indigenous and Appropriate Technology Education
Area Strand: Secondary Education

The call to decolonise and indigenise science is an ongoing debate in the world. It is against this background that in this study we sought to explore how the mobilisation of the indigenous technology of oil extraction (okuyenga) from marula nuts and melon seeds influenced (or not) Grade 10 Biology learners' perspectives and sense-making of the topic of enzymes. The study was located within the interpretive and indigenous research paradigms. Informed by the sociocultural theory, data were gathered through participatory observation and journal reflections. The findings of the study revealed that the presentations on the indigenous technology of oil extraction by the expert community members influenced learners' perspectives and sense-making of enzymes and other science concepts. The study thus recommends that teachers should make efforts to collaborate with expert community members who are the custodians of indigenous knowledge and tap into their cultural heritage to enrich teaching in their science classrooms.

T2023_007_SP

SUSTAINABLE LAND MANAGEMENT: LESSONS FROM NIGERIAN ROOT AND TUBER FARMERS

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Presentation type: Short Paper
Subject Strand: Indigenous and Appropriate Technology Education
Area Strand: Out of School Education

Sustainable land management is the forte of the indigenous people as their relationship with the land is one of reverent use and forms the basis of all forms of production hence care is taken not to misuse it. Focus group discussion, semi-structured interviews and participant's observation were employed during data generation. An inductive thematic analysis was applied on the data. Sustainable land management by the farmers starts from site selection with the use of indigenous knowledge of plants as indices for fertility, use of simple implements for tillage to preserve the soil structure, use of manure/incorporating crop/plant residue, weeding, minimal use of herbicides up to crop storage. Major themes identified include: fertility management, water conservation, pest control and cultural practices. The study concluded that incorporating these practices into mainstream Agricultural education will engender better use of the land.

T2023_008_SP

THE ROLE OF INDIGENOUS KNOWLEDGE METHODOLOGY IN NEGOTIATING RESEARCH WITH FARMERS AND STAKEHOLDERS REGARDING CLIMATE CHANGE.

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Presentation type: Short Paper
Subject Strand: Indigenous and Appropriate Technology Education
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This paper focuses on the role of indigenous knowledge methodology in negotiating research with farmers and stakeholders regarding climate change. Indigenizing methodology reduces the rigor of trying to use western criteria/lens to study indigenous issues and contexts, a process that may impact negatively on the reliability of the data generated in such studies. The use of indigenous methods of ìjíròrò egbé (focus group discussion), ìfòròjomitoroòrò (interviews), àkíyèsí alabaṣe (participants' observations) and ìtàn síso (storytelling) as well as vast knowledge of the culture of the participants are criteria that should be adhered to when conducting studies in the indigenous paradigm. The study highlights the importance of language, respect of the people's beliefs and value system, the context of the field study as well as cultural compliance and concluded that the peculiarities of each culture and context should be taken into consideration in the selection of methodology for each study and methods should be adapted to suit such.

T2023_010_SP

ASSESSMENT FOR LEARNING: A TECHNOLOGY EDUCATION CONTEXT

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Presentation type: Short Paper
Subject strand: Technology Education
Area strand: Secondary Education

This paper is based on the premises that the purpose of assessment in Technology Education is to engaging learners in design-based multifaceted technical learning activities aimed at cultivating technological literacy. Technology Education literature suggest that Technology teachers do not align relevant teaching practices to realise the educational goal of Technology Education curricula in general. The data suggest that Senior Phase Technology teachers have diverse views and understanding of the implementation of assessment strategies as they employ design thinking teaching strategies. There is a need for deeper teacher knowledge on the educational intention of the Technological Process as a teaching and learning strategy geared to cultivate both teaching and learning habits in the Senior Phase Technology. We argue that until senior phase Technology teachers understand the theoretical and philosophic underpinning of the design-based discipline-specific teaching strategy, the implementation of relevant assessment and pedagogical practices will continue to be compromised.

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