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humanity s love affair with mathematics and mysticism reached a critical juncture legend has it on the back of a turtle in ancient china as clifford pickover briefly recounts in this enthralling book the most comprehensive in decades on magic squares emperor yu was supposedly strolling along the yellow river one day around 2200 b c when he spotted the creature its shell had a series of dots within squares to yu s amazement each row of squares contained fifteen dots as did the columns and diagonals when he added any two cells opposite along a line through the center square like 2 and 8 he always arrived at 10 the turtle unwitting

inspirer of the yu square went on to a life of courtly comfort and fame pickover explains why chinese emperors babylonian astrologer priests prehistoric cave people in france and ancient mayans of the yucatan were convinced that magic squares arrays filled with numbers or letters in certain arrangements held the secret of the universe since the dawn of civilization he writes humans have invoked such patterns to ward off evil and bring good fortune yet who would have guessed that in the twenty first century mathematicians would be studying magic squares so immense and in so many dimensions that the objects defy ordinary human contemplation and visualization readers are treated to a colorful history of magic squares and similar structures their construction and classification along with a remarkable variety of newly discovered objects ranging from ornate inlaid magic cubes to hypercubes illustrated examples occur throughout with some patterns from the author s own experiments the tesseracts circles spheres and stars that he presents perfectly convey the age old devotion of the math minded to this zenlike quest number lovers puzzle aficionados and math enthusiasts will treasure this rich and lively encyclopedia of one of the few areas of mathematics where the contributions of even nonspecialists count fans of sudoku may not know that the game is a recent offshoot of the venerable magic square which dates back more than 4 000 years to ancient china this book provides a delightful account of the mind boggling variety possible with magical squares a bestseller in its french edition this book is original in its construction and its success in the french market demonstrates its appeal it is based on three principles 1 an organization of the chapters by families of algorithms exhaustive search divide and conquer etc on the contrary there is no chapter devoted only to a systematic exposure of say algorithms on strings some of these will be found in different chapters 2 for each family of

algorithms an introduction is given to the mathematical principles and the issues of a rigorous design with one or two pedagogical examples 3 for the most part the book details 150 problems spanning seven families of algorithms for each problem a precise and progressive statement is given more importantly a complete solution is detailed with respect to the design principles that have been presented often some classical errors are pointed out roughly speaking two thirds of the book is devoted to the detailed rational construction of the solutions every mathematician beginner amateur and professional alike thrills to find simple elegant solutions to seemingly difficult problems such happy resolutions are called aha solutions a phrase popularized by mathematics and science writer martin gardner aha solutions are surprising stunning and scintillating they reveal the beauty of mathematics this collection includes one hundred problems in the areas of arithmetic geometry algebra calculus probability number theory and combinatorics the problems start out easy and generally get more difficult as you progress through the book a few solutions require the use of a computer an important feature of the book is the discussion of related mathematics that follows the solution of each problem this material is there to entertain and inform you or point you to new questions traditional magic squares employ a chessboard like arrangement of numbers in which the total of all rows columns and diagonals add up to the same number this innovative approach by a dutch engineer challenges puzzlists to think two dimensionally by replacing numbers with colorful geometric shapes dozens of creative puzzles suitable for ages 12 and up the concept of a magic square is of ancient origin the simple 3 by 3 square called lo shu being the first to appear the cells of a magic square are populated with consecutive positive integers in such a way that all rows and columns have the same sum magic polygons presents a natural

generalization which involves polygons with more than 4 sides a polygon is first tiled with parallelograms with the result that sequences of parallelograms with mutually parallel sides form streams which extend from one boundary edge to an opposite boundary edge these streams form the analog of rows and columns in a magic square the tiles are labeled with integers so that all streams have the same sum instead of using the positive integers 1 2 3 to label the tiles various abelian groups are used thus adding a further new dimension to the constructions related topics such as latin polygons magic cylinders and magic circle systems are also introduced these magic square puzzles in this book consist of 49 rectangles built as a 7x7 rectangle shape abstract of book this volume contains the papers presented at the international conference building on the past to prepare for the future held from august 8 13 2022 in king s college cambridge uk it was the 16th conference organised by the mathematics education for the future project an international edu ca tional and philanthropic project founded in 1986 and dedicated to innovation in mathematics statistics science and computer education world wide contents list of papers and workshop summaries fouze abu qouder miriam amit the ethnomathematics of the bedouin an innovative approach of integrating socio cultural elements into mathematics education doi org 10 37626 ga9783959872188 0 001 first page 1 last page 6 abstract our study attempted to address young bedouin desert tribes students persistent difficulties with mathematics by integrating ethnomathmematics into a standard curriculum first we conducted extensive interviews w 35 bedouin elders and women to identify 1 the mathematical elements of their daily lives particularly traditional units of length and weight 2 the geometrical shapes in bedouin women s traditional dress embroidery then we combined these with the standard curriculum to make an integrated 90 hours 7 8th grade

teaching units that were implemented in bedouin schools and in the kidumatica math club for excellent students comparisons between the experimental groups 186 and the control group 62 showed that studying by the integrated curriculum improved 1 the cognitive aspects of the students 2 the affective aspects keywords bedouin cultures ethnomathematics nadine adams clinton hayes why everyone should know statistics doi org 10 37626 ga9783959872188 0 002 first page 7 last page 11 abstract decision is the central intellectual activity in our everyday lives and statistics is central to these activities longford 2021 p xi the ability to manipulate and interpret data is an important component in decision making a misunderstanding or poor grasp of data distributions and statistical methods can lead to assumptions that are not accurate when these inaccurate assumptions are presented as factual to decision makers also possessing little or no statistical knowledge poor decisions can be made this paper investigates how an interpretation of statistics played a role the decision to remove multiple choice questions from invigilated examinations at a regional australian university the case is further argued that it is important for everyone to have a basic understanding of statistics anita n alexander the perspectives of effective teaching and learning of current undergraduate and graduate mathematics students doi org 10 37626 ga9783959872188 0 003 first page 12 last page 17 abstract some mathematics professors engage their students in discourse and explorations to promote a deep understanding of critical concepts still lecture remains the norm in mathematics courses according to current mathematics students survey responses mostly lecture 52 lecture discussions 35 n 89 students were asked the best way for them to learn mathematics whether their career plans are teaching related teaching related yes 22 not sure 36 no 42 as well as what they enjoy and want to change about their mathematics courses

students requested more discussions and more questions to solve in class and described lecture as an unacceptable way to teach and that it is the worst way to learn students perspectives on effective teaching and learning are critical for their continued passion to pursue stem related fields rather than stating that i do not love mathematics anymore clement ayarebilla ali ernest kofi davis applications of basketry to geometric tessellations doi org 10 37626 ga9783959872188 0 004 first page 18 last page 23 abstract we present applications of basketry to geometric tessellation in the primary school mathematics even though there are various forms of tessellations we present three regular and archimedean tessellations for conceptual analysis of the geometric concepts with a case study design of 15 pupils through interviews and observations the findings show that pupils can apply baskets to learn geometric tessellations it was there recommended that baskets be used to extend learning as they play game and fun nurten alpaslan emre alpaslan mathematics for everybody doi org 10 37626 ga9783959872188 0 005 first page 24 last page 25 cynthia oropesa anhalt ricardo cortez brynja kohler will tidwell interrogation of social justice contexts in mathematical modeling the use of simulations of practice in the mathematical preparation of teachers doi org 10 37626 ga9783959872188 0 006 first page 26 last page 31 abstract research in prospective teachers development of mathematical modeling knowledge for teaching is gaining momentum the mathematics of doing understanding learning and educating for secondary students module s2 project developed a curriculum in modeling for teacher education that includes simulations of practice in which prospective teachers reflect on and plan a discussion around student thinking their models and the contextualization of their results we present an analysis of prospective teachers modeling work on the decreasing area of indigenous reservation land in the u s and a

simulation of practice which explores different methods for finding the area of land in connection to the injustice deeply rooted in the treatment of indigenous people this problem explores a critical social issue and calls for explicit attention to pedagogical knowledge in structuring discussions around the contextualization of the mathematical results takako aoki shin watanabe find out mathematics on a football making a football with paper doi org 10 37626 ga9783959872188 0 007 first page 32 last page 34 abstract we are aiming for a workshop method as a way to teach mathematics in future school education it is important to cooperate with each other and understand mathematics in this workshop we aim to discover the mathematics hidden in the footballs we handle every day as an aid to thinking i would like to make football by paper first and learn mathematics while looking at concrete things you need 20 equilateral triangles a regular hexagon is made from this equilateral triangle and a regular pentagon uses the method of making a hole in particular pay attention to the four color problem in mathematics make sure that the colours of adjacent regular hexagons are different and use three colours red green yellow for example in a football how many equilateral triangles of each colour are used is one of the issues i am looking forward to holding a workshop to see what kind of problems there are key words football introduction with paper the truncated icosahedron the color coding of the three colors euler s polyhedral formula sarah bansilal analysing the demands of an assessment in a geometry pedagogic content knowledge module doi org 10 37626 ga9783959872188 0 008 first page 35 last page 40 abstract with the onset of the pandemic universities were forced to move to online platforms for teaching and for assessments in this paper i reflect on the use of multiple choice questions in a geometry pck module for pre service mathematics teachers the study involves a secondary analysis of the data

generated by the responses of 92 students to an assessment consisting of 25 items the aim of the study was to distinguish between and if possible characterise possible levels of demands of the test items the results suggested that there are four distinct groups of items relating to common content knowledge of early and late high school respectively pck related to deductive reasoning skills and critical thinking in an open book setting mike bedwell three or four numbers a teacher s tale doi org 10 37626 ga9783959872188 0 009 first page 41 last page 43 esther billings lisa kasmer learning experiences that support primary teacher candidates understanding and enactment of core mathematics teaching practices doi org 10 37626 ga9783959872188 0 010 first page 44 last page 49 abstract in many teacher preparation programs instruction focuses on learning about strategies and practices for teaching rather than directly enacting and honing these skills grossman hammerness mcdonald 2009 a corepractice approach in teacher education necessitates organizing coursework and fieldwork around practices of the teaching profession while simultaneously providing teacher candidates tcs ample opportunities to practise by enacting these teaching practices in this paper we share our corepractice instructional strategies along with tc work used in our teacher preparation mathematics education courses prior to student teaching to engage tcs understanding and development of their ability to enact core practices specifically the mathematics teaching practices outlined in national council of teachers of mathematics nctm 2014 victoria bonaccorso joseph dinapoli eileen murray promoting meaningful conversations among prospective mathematics teachers doi org 10 37626 ga9783959872188 0 011 first page 50 last page 55 abstract recent circumstances due to the covid 19 pandemic and restrictions on entering public schools have created barriers for

prospective teachers pt to gain valuable exposure to real classrooms as a result we have transitioned some teacher preparation from in person experiences to video case study analysis our research seeks to determine how this transition can foster development of critical teaching skills by infusing a model of powerful teaching with video of real classrooms our findings suggest that with online video case analysis pts were able to advance their discursive conversations to strategic conversations by building on and transforming each other s articulation of proposed teacher moves this model for pt preparation has the potential to foster more meaningful discourse among participants by providing a space to build on and refine their understanding of mathematics teaching primo brandi rita ceppitelli anna salvadori elementary dynamic models a strategic bridge connecting school and university doi org 10 37626 ga9783959872188 0 012 first page 56 last page 62 abstract we present an innovative educational path thought as a link between high school and university studies the topic is the introduction to dynamic models both discrete and continuous which represent a key tool in a wide range of disciplines sciences techniques economics life sciences and more simone brasili riccardo piergallini introducing symmetry and invariance with magic squares doi org 10 37626 ga9783959872188 0 013 first page 63 last page 68 abstract magic squares are key tools in mathematics teaching they favor reasoning and creativity in problem solving as well they bring students closer to the history of mathematics our work presents the magic squares in a learning progression introducing the symmetry linked with the idea of invariance sameness in change early at primary school in montegranaro italy using the 3x3 magic square and manipulation games a sample of 101 pupils 8 years internalizes symmetries reflections and rotations associated with the square the proposed

activities provide tools and experience for geometric cognitive processes transferable from magic squares to main geometric shapes the findings confirm that symmetry linked to the search for invariance is appropriate and accessible for primary school pupils through manipulation games angela broaddus matthew broaddus assessing mathematical reasoning test less explain more doi org 10 37626 ga9783959872188 0 014 first page 69 last page 74 abstract mathematics educational researchers have long offered recommendations for effective mathematics teaching learning and assessment yet educators still struggle to implement fair and practical assessments that promote engagement and inspire students this study describes assessments that 1 reduced anxiety frustration and rote imitation of procedures 2 increased accessibility motivation and psychological resilience and 3 improved engagement strategic competence self assessment and depth of understanding writing assignments prompted students to explain their reasoning about problems or their understanding of main ideas students revisited assignments in response to feedback and resubmitted them later in the course which motivated students to deepen their understanding over time sample assignments responses and lessons learned will be shared irena budínová jitka panáčová children with reduced cognitive effectivity their problems and optimal way of education doi org 10 37626 ga9783959872188 0 015 first page 75 last page 80 abstract the contribution deals with children with reduced cognitive efficiency their specific and frequent difficulties in learning mathematics in the first years of education two examples of children with reduced cognitive efficiency will illustrate the specific ways in which reduced cognitive efficiency can manifest itself in mathematics how children can be helped to overcome the mathematics curriculum problems in learning two basic arithmetic operations will

be presented the differentiation of teaching will be briefly introduced as an effective opportunity to work with these children gail burrill data science and mathematical modeling connecting mathematics to the world in which students live doi org 10 37626 ga9783959872188 0 016 first page 81 last page 89 abstract the increasing need for statistical and quantitative thinking and reasoning makes it more important than ever that using mathematics and statistics to make sense of the world should be a central component of schooling data have transformed the way we look at the world shouldn t this emphasis on data also impact what we teach both in mathematics and statistics research suggests that engaging with real data can motivate students encourage them to take an interest in stem fields and allows the interests of diverse communities to be used as opportunities for learning this paper summarizes the research looking at why connecting mathematics to the world is important for student learning describes the role of data science and modeling in doing so and provides examples of opportunities for students to interact with the world in which they live and work the development of mathematics is intimately interwoven with the progress of civilization ebrahim 2010 gail burrill thomas dick connecting mathematics to the world engaging students with data science doi org 10 37626 ga9783959872188 0 017 first page 90 last page 94 abstract mathematics and statistics can be used to describe explore and understand this complicated world in which we live the workshop focus is on several potentially messy real world problems from predicting herd immunity to exploring the quality of life across countries to modeling the change in co2 levels each situation begins with a question and a set of data the activities are open ended with multiple ways students might develop mathematical and statistical models use technology to analyze the data and make sense of terms such as herd immunity or vaccine

efficacy or to investigate situations such as optimizing resources during a flood elizabeth a burroughs mary alice carlson fostering empathy in mathematics through mathematical modeling doi org 10 37626 ga9783959872188 0 018 first page 95 last page 100 abstract modeling a cyclic process by which mathematicians develop and use mathematical tools to represent understand and solve problems provides learning opportunities for school students mathematical modeling situates mathematical problem solving squarely in the middle of everyday experiences modeling engenders the habits and dispositions of problem solving and empowers students to identify critical issues important to them use their mathematical tools to address these problems and view mathematics as a force for societal good bernardo camou the adventure of learning mathematics and lakatos s legacy doi org 10 37626 ga9783959872188 0 019 first page 101 last page 104 abstract mathematics is normally described as abstract exact general and perfect however mathematics is a human creation and thus we can ask how can humans with flaws and defects are able to create something perfect and infallible mathematics have its foundations in concrete problems trials and errors approximations and representations learning mathematics is a fascinating trip back and forth between concrete and abstract between approximations and accuracy between particular and general our poor representations are the road to conceptualize mathematical objects that then seem to become perfect in this workshop we will handle polyhedral and work with euler s formula with angular defects and its relation with surface s curvature in lakato s book proofs and refutations the author might have committed a mistake though his book gives us a brilliant insight about the logic of mathematical discovery carrie chiappetta christopher walsh annie smith javier perez k 12 schools after the global pandemic how a regional school district in the united states accelerated learning for

students teachers administrators doi org 10 37626 ga9783959872188 0 020 first page 105 last page 110 abstract after the global pandemic regional school district 15 will start the 2021 2022 school year by accelerating learning for students teachers and administrators for teachers the focus will be on purposeful planning differentiation and formative assessment to ensure that all students learn grade level content for administrators the focus would be on supporting teachers in these three areas of focus the assistant superintendent the mathematics science department chair and the elementary and middle school mathematics instructional coaches will share the plan that they have implemented to work with k 12 teachers and administrators to ensure that students were able to learn grade level content even after the interrupted education that occurred during the global pandemic kathleen cotter clayton fractions of the future doi org 10 37626 ga9783959872188 0 021 first page 111 last page 116 abstract explore the simplicity and beauty of fractions of the future with a linear model not with circle sets when fractions are approached with this linear perspective fractions can be easily taught explored and applied in daily life learn how to ask the right questions to guide your pupils to a solid understanding children as young as five can see that 1 3 is less than 1 2 and more than 1 4 they can also see why 9 8 is more than 1 why 1 4 plus 1 8 is 3 8 and why 1 2 1 2 is 1 4 fractions are a delight when they are taught the right way allow the children to explore the whole picture and relationships within the whole using the linear fraction model learn about activities and games to build confidence and develop a deep understanding of fractions uncover the joy of fractions joan a cotter teaching primary mathematics without counting and place value with transparent number naming doi org 10 37626 ga9783959872188 0 022 first page 117 last page 122 abstract counting memorizing the

sequence and coordinating pointing with recitation is problematic for many children children with poor counting skills often struggle to learn their beginning math with various approaches yet counting is unnecessary babies are born with the ability to subitize that is to detect quantities at a glance up to three by age 3 they can subitize up to five by age 4 they can subitize up to 10 by grouping in fives similar to their fingers after children know the names for quantities 1 to 10 their next step should be place value starting with temporary transparent number naming for example 11 is ten 1 12 is ten 2 and 24 is 2 ten 4 the counting words in far asian languages reflect this transparency enhancing their pupils mathematics achievement place value knowledge combined with subitizing gives pupils a way to master number combinations celisa counterman m a t h making algebraic thinking holistic doi org 10 37626 ga9783959872188 0 023 first page 123 last page 127 abstract students in mathematics often need more than just definitions and examples the first step is leaving their anxiety at the door hands on work engages students by utilizing group learning discovery and active learning both with and without technology lessening the fears of math faculty members will be given sample activities rubrics and sample student work special focus on creating spirolaterals and quilting teach geometric movement and pattern recognition puzzles are created with mathematical problems in linear equations linear inequalities and compound inequalities bringing the focus on skills and historical facts faculty members will work in teams to recreate the materials themselves to see where issues in understanding come from there will be time for both questions and answers scott a courtney the impact of remote instruction on mathematics teachers practices doi org 10 37626 ga9783959872188 0 024 first page 128 last page 133 abstract the coronavirus pandemic has impacted all aspects of society as the virus

spread across the globe countries and local communities closed workplaces moved schools to remote instruction limited in person contact cancelled public gatherings and restricted travel at one stage over 91 3 of students worldwide from pre primary through tertiary education were impacted by school closures in the united states many institutions continue to provide remote and hybrid learning options throughout the 2021 2022 academic year attempts to mitigate covid 19 through mass remote instruction has provided unique opportunities for researchers to examine the resources teachers utilize to drive and supplement their practices in this report i describe remote instruction s ongoing impact on grades 6 12 mathematics teachers and their students in rural area and small town schools in the midwestern united states mili das building on the past to prepare for the future impact of teaching skills and professionalism to reduce mathematics phobia doi org 10 37626 ga9783959872188 0 025 first page 134 last page 138 abstract in india mathematics is a compulsory subject for the primary upper primary and secondary classes in secondary school curriculum among the compulsory subjects mathematics is the most vital subject and at the same time it is the most difficult one as per the learners opinion as well as the parents so the subject is neglected by many students and as a consequence mathematics phobia is often developed in the students mind there are many more factors which are connected to this growing distaste in learning mathematics like in appropriate curriculum organization methodology of teaching teachers knowledge assessment techniques das m 2010 and management of classroom environment the said problem is not a new one but in present teachers training course special attention is given on it in this paper author will discuss that how the teaching skills and teachers professionalism can create a positive environment to motivate students

keywords mathematics teacher learners curriculum professionalism thomas p dick combining dynamic computer algebra and geometry to illustrate the most marvelous theorem in mathematics doi org 10 37626 ga9783959872188 0 026 first page 139 last page 144 abstract dynamic geometry software dgs allows for constructions and measurements that instantly update when a virtual geometric figure is manipulated likewise dynamic computer algebra systems cas enable symbolic calculations that instantly update when an expression or equation is altered linking geometric objects to symbolic parameters combines these two powerful tools together we will illustrate a unique feature of locked measurement in a special dgs to create a steiner ellipse we then illustrate the use of a dynamic cas to create dynamic first and second derivative zeroes of a cubic function whose zeroes can be graphically manipulated finally we will link a dynamic geometric construction based on these zeroes to illustrate the siebeck marden theorem an astounding result that has been justifiably called the most marvelous theorem in mathematics hamide dogan angel garcia contreras edith shear geometry imagery and cognition in linear algebra doi org 10 37626 ga9783959872188 0 027 first page 145 last page 150 abstract this paper discusses features of five college level linear algebra students geometric reasoning revealed on their interview responses to a set of predetermined questions from topics relevant to linear independence ideas our qualitative analysis identified three main themes topics each theme furthermore revealed similarities and differences providing insight into technology s potential effect ann dowker olivia cheriton rachel horton age differences in pupils attitudes to mathematics doi org 10 37626 ga9783959872188 0 028 first page 151 last page 156 this study investigated children s and adolescents attitudes to mathematics with a particular focus on whether and how these are

affected by age and gender 216 pupils from years 2 6 9 and 12 participated in the study they were given 1 the mathematics attitude and anxiety questionnaire thomas dowker 2000 which assesses levels of maths anxiety unhappiness at failure in maths liking for maths and self rating in maths and 2 the british abilities scalesnumber skills test to establish actual mathematics performance age had a significant effect on both liking for maths and selfrating in maths older children were lower than younger children in both gender had a significant effect on self rating boys rated themselves higher than girls though there was no significant gender difference in mathematical performance self rating but not anxiety predicted mathematics performance alden j edson elizabeth difanis phillips the potential of digital collaborative environments for problem based mathematics curriculum doi org 10 37626 ga9783959872188 0 029 first page 157 last page 162 abstract in this paper we present an overview of the design research used to develop a digital collaborative environment with an embedded problembased curriculum we then discuss the student and teacher features of the environment that promote inquiry based learning and teaching belinda p edwards learning to teach mathematics using virtual reality simulations doi org 10 37626 ga9783959872188 0 030 first page 163 last page 168 abstract researchers lampert et al 2013 zeichner 2010 grossman et al 2009a recommend the use of rehearsals in teacher education classrooms to help preservice teachers pst bridge theory to practice rehearsals enable psts to practice teacher moves such as asking purposeful questioning and engaging students in mathematical discourse during an episode of teaching a lesson nctm 2014 during a rehearsal the pst s teacher education instructor provides coaching that helps the pst make flexible adjustments to their instruction using a phenomenological approach this research

investigates the use of virtual reality vr simulations to support psts learning to teach mathematics through rehearsals the presentation will include samples of psts mathematics teaching episodes with attention to successes challenges and lessons learned from the use of vr simulations in teacher education classrooms allison elowson kristen fye gregory wickliff christopher gordon alisa wickliff paul hunter david pugalee student research in a mathematics enrichment program doi org 10 37626 ga9783959872188 0 031 first page 169 last page 174 abstract increasing emphasis is placed on the development of research skills for students in stem content areas as part of a four week summer enrichment program 24 high school students participated in a mathematics course highlighting the historical development of mathematics through the lens of history and culture each student designed and conducted their own research study under the mentorship of instructors with expertise in mathematics writing and technical communication and student research this paper presents a case study of one project selected on the basis of strong performance in meeting course goals data demonstrates the mathematical understanding of the student researcher their scientific literacy and research skills and their mathematical communication the student prepared both a paper and a poster to report their research study antonella fatai improving relational and disciplinary competences by rondine method doi org 10 37626 ga9783959872188 0 032 first page 175 last page 180 abstract the present work describes an educational experience being implemented since 2015 based on the rondine method application in mathematics teaching this experience has involved 135 students from state schools throughout italy the general method was developed by an italian research team aiming at resolving conflicts in situations of contrast the goal of the work is highlighting how the care of

relationships may be a means for overcoming difficulties in mathematics below we describe activities referring to the general principles of active education and of socio constructivism which are oriented to train students both in learning by action and participation and in bringing their own contribution to the whole class work courtney fox integrating mathematics and science a plan for a high school integrated pre calculus and physics course doi org 10 37626 ga9783959872188 0 033 first page 181 last page 185 abstract this paper explores the integration of mathematics and science as a means to improve learning for high school students scholars have acknowledged the benefits of integration for over 50 years but in the united states we have failed in large measure to adopt an integrative curriculum this work provides a corrective to this problem by creating a practical curriculum for an integrated pre calculus and physics course with suggestions for implementation in any school kathy r fox building an understanding of family literacy changing perspectives regarding authentic learning opportunities in the home doi org 10 37626 ga9783959872188 0 034 first page 186 last page 191 abstract home to school engagement has often been a one way path with teachers seen as facilitators only when schools were forced to rapidly switch to virtual instruction teachers were suddenly entering kitchens living rooms and other spaces to deliver virtual instruction findings from this qualitative study of eleven practicing teachers showed new teaching opportunities through virtual home visits doors were literally and figuratively opened as teachers became beneficiaries of cultural and academic practices in the home math instruction took on a real world quality as teachers were privy to home environments for authentic teaching materials as schools open and teacher parent and caregiver relationships return to a more distant space these participants described small but significant changes in the

way they continued to engage parents and caregivers after the experiences of the virtual home visits grant a fraser mathematics for living a course that focuses on solving problems in today s world doi org 10 37626 ga9783959872188 0 035 first page 192 last page 195 abstract the author has developed and taught a course for university students who are not specializing in mathematics science or engineering in contrast to traditional courses of this type this course focuses on topics from the real world that students will encounter in later life the aim of the course is to provide students with mathematical tools that they can use to create meaningful practical solutions to problems that arise in these topics students work individually on projects and present their solutions in class other students then critique these solutions with practice students develop the skills necessary to analyze more complicated kinds of problems a final project enables students to use their newly acquired techniques to deal with more realistic problems the author discusses the content of the course and the impact it has had on students toshiakira fujii roles of quasi variables in the process of discovering mathematical propositions doi org 10 37626 ga9783959872188 0 036 first page 196 last page 201 abstract the purpose of this paper is to clarify roles of quasi variables by focusing on the process of discovering mathematical propositions for this purpose the author analyzed the assignment reports of third year undergraduate students as a result the author found that looking back is important in the generalization oriented inquiry process but it is not enough it is important to re examine the found matter and its form of expression from the perspective of a new concept in the process of looking back and re examine it was confirmed from the description of the metacognitive part of the students that the use of quasi variables clarified the object of consideration and made it easier to clarify which numbers contributed to

the generalization and expansion in what sense ben galluzzo katie kavanagh karen bliss michelle montgomery christopher musco math modelling common pitfalls and paths for student success doi org 10 37626 ga9783959872188 0 037 first page 202 last page 207 abstract mathematical modelling refers to the process of creating a mathematical representation of a real world scenario to make a prediction or provide insight there is a distinction between applying a formula and the actual creation of a mathematical relationship approaching open ended problems can be challenging for students in this two part workshop we first share examples of how students can get off track while creating models in particular making choices or assumptions that undermine the solution quality in the second part we demonstrate how to facilitate authentic math modelling so that students can be creative and innovative in the modelling process while having ownership over their solution participants will assess real student modelling solutions from mathworks math modeling challenge m3 challenge a program of society for industrial and applied mathematics siam and discuss ways that they would advise teams towards improvement parker glynn adey ami mamolo modelling beauty hands on experiences in group theory doi org 10 37626 ga9783959872188 0 038 first page 208 last page 213 abstract in the 19th century geometric models were valued as tools for exploring complex mathematics quartic surfaces and hyperboloids elaborately modelled with plaster gave access to powerful ideas and brought alive wonderful new mathematics in this workshop we explore a diverse set of geometric models that capture mathematical beauty and we showcase how they can be used to bring alive wonderful new for students mathematics we discuss the value of these experiences for fostering mathematical ways of being that can help disrupt preconceived notions about a homely rote and rigid nature of mathematics and

capture some of the visual richness of older mathematical models gerald a goldin lisa b warner roberta y schorr daniel colaneri exploring prospective mathematics teachers motivating desires during group problem solving activity doi org 10 37626 ga9783959872188 0 039 first page 214 last page 219 abstract earlier research has characterized recurrent patterns of cognition affect and behavior during in the moment mathematical activity each pattern termed an engagement structure is named by a specific motivating desire that evokes it e g get the job done i m really into this value my culture etc this study explores prospective teachers motivating desires as they engage in small group problem solving sessions participants were enrolled in courses required for teaching certification at two eastern u s state universities based on survey individual interview and focus group data we identify the most frequently occurring desires their perceived importance and accompanying emotional feelings we present and discuss some findings briefly including the motivating desire to carry my weight with a team of peers john gordon kehinde emmanuel adenegan are abstract mathematical thinkers born or can they be trained doi org 10 37626 ga9783959872188 0 040 first page 220 last page 224 abstract abstract mathematical thinkers in the fields of pure mathematics and theoretical computer science have contributed significantly to the body of knowledge that has fundamentally altered the course of human civilization and technological advances this paper explores whether these thinkers are naturally gifted or if there are pedagogical strategies that can be implemented that will bring about the same outcomes keywords abstract critical thinkers mathematics john gordon reuniting exponents and logarithms teaching exponents inverse functions and logarithms as one cohesive pedagogical unit doi org 10 37626 ga9783959872188 0 041 first page 225 last page 230 abstract exponents inverse

functions and logarithms are fundamentally important concepts in almost every branch of technical science however they are not taught together as a cohesive comprehensive pedagogical unit in many instances as a result students lose deep insight into their meaning and applicability additionally particularly in the concept of the inverse function the richness and beauty inherent in the concept are reduced to a purely mechanical process this paper seeks to remedy this situation by outlining a pedagogical strategy that links exponents inverses and logarithms together in such a manner as to preserve their natural dependence coherency and logic keywords exponents inverse functions logarithms debra hydorn infographics to develop graphical literacy doi org 10 37626 ga9783959872188 0 042 first page 231 last page 236 abstract tools for easily creating infographics are widely available both online and through statistics mathematics and other programs determining the appropriate graphs to produce for different kinds of data is an important skill for students at all levels to learn as is determining the best graph for a specific audience with the increased availability of data comes the increased expectation that researchers in all disciplines can effectively communicate their findings to a wide range of audiences experts in graphical design have defined aspects of graphical excellence but the effectiveness of graphically portrayed information depends a great deal on the needs and abilities of the intended audience to create effective graphs students not only need to be familiar with tools for creating graphs they also need to be familiar with the communication cognitive and aesthetic principles associated with infographic design andrew izsák foregrounding multiplicative structure in essential calculus topics doi org 10 37626 ga9783959872188 0 043 first page 237 last page 242 abstract approaches to calculus have emphasized limits derivatives and integrals

among other topics yet across different approaches the subject continues to pose significant challenges the present study reports a new approach to calculus that takes multiplicative structure as an equally essential topic that is often overlooked or taken for granted in an experimental course 18 college students learned to reason about multiplication understood as coordinated measurement with two different units and proportional relationships understood from the variable parts perspective they then worked with piecewise linear functions and step functions to derive key calculus results a first strand involved division proportional relationships slopes of lines function composition and the chain rule a second strand involved multiplication areas inversely proportional relationships and integration by substitution brian l johnson ioannis gkigkitzis interesting facts about terminating decimals doi org 10 37626 ga9783959872188 0 044 first page 243 last page 248 abstract the set of rationals is dense in r in fact this is even true for the smaller family of terminating decimals unlike density ratios in the physical world this is an absolute property implying that infinitely many such decimals exist in even the smallest intervals we can imagine however it is possible to construct this infinite density in an increasing sequence of finite densities starting with the discrete set of integers while the terminating decimals do not seem to receive as much formal discussion as z q and r they are an essential part of the mathematics curriculum from elementary school through college keywords integers rational numbers algebra density iris deloach johnson exploring a collection of approachable stimulating and thought provoking problems face to face or virtual related or not doi org 10 37626 ga9783959872188 0 045 first page 249 last page 253 abstract students thrive when engaged in solving problems that they find to be approachable stimulating and thought provoking this workshop includes many such problems with

various real world and contrived contexts participants will work in groups to find the solutions as well as identify similarities and contrasts among the problems we will explore whether there are related mathematical concepts e g algebra discrete mathematics geometry or mathematical processes reasoning connecting communicating representing problem solving selecting tools and strategies many of these problems are taken from resources published broadly for students from ages 11 19 we will compare our findings and experiences with those of school students and discuss use of technology in both face to face and online settings from the past to the future keywords problem solving reasoning communication collaboration algebra representations chalk talk thinker doer problems gibbs y kanyongo nandini bhowmick erika williams structural equation modeling focus on confirmatory factor analysis doi org 10 37626 ga9783959872188 0 046 first page 254 last page 255 abstract this workshop will expose participants to the statistical technique of structural equation modeling sem with a focus on confirmatory factor analysis cfa using the statistical software amos structural equation modeling is a multivariate statistical analysis technique that is used to analyze structural relationships confirmatory factor analysis examines whether collected data fit a hypothesized model of what the data are meant to measure it is the measurement part of sem which shows relationships between latent variables and the observed variables anna khalemsky yelena stukalin combining various data mining techniques in binary classification teaching doi org 10 37626 ga9783959872188 0 047 first page 256 last page 260 abstract binary classification is one of the most common data analytics tasks it appears in a wide range of applications including finance sociology psychology education medicine and public health in statistical and analytics courses binary

classification is usually handled by logistic regression other alternatives such as decision trees neural networks and naïve bayes are not commonly taught in traditional undergraduate programs we suggest making these methodologies accessible as alternatives or complementary approaches to binary classification we treat the teaching of the subject as a dynamic process that involves the understanding of the analytical task understanding terms and concepts visualizing analyzing interpreting the results and decision making richard kitchen leveraging pólya s heuristic to support mathematical reasoning and language development doi org 10 37626 ga9783959872188 0 048 first page 261 last page 266 abstract an iteration of an instructional framework designed to provide emergent bilinguals ebs with opportunities to simultaneously engage in mathematical reasoning and learn the language of mathematics is illustrated in this paper the discursive mathematics framework dmf builds on pólya s iconic problem solving heuristic by integrating research based language practices and essential teaching practices videotapes and student work from problem solving lessons were examined using grounded theory methodology to illustrate the development of the dmf theoretically this study contributes to the literature by providing explicit examples of how practices that promote mathematical reasoning and the learning of the language of mathematics can be taught concurrently during problem solving lessons sergiy klymchuk an innovative way of teaching and assessing critical thinking in mathematics doi org 10 37626 ga9783959872188 0 049 first page 267 last page 272 abstract this paper deals with the use of deliberately misleading mathematics questions in teaching and assessment as an innovative pedagogical strategy the intention of using such questions is to enhance students critical thinking critical thinking is understood here as examining

questioning evaluating and challenging taken for granted assumptions about issues and practices as defined by the new zealand ministry of education the study is based on a survey of 82 secondary school mathematics teachers who attended introductory workshops on the suggested pedagogical strategy at their regional conferences although the vast majority of the participants 96 agreed to use such strategy in teaching only 63 percent of the participants were willing to use it in assessement teachers attitudes are analysed in the paper key words critical thinking assessement school mathematics teachers allison m kroesch albert otto magic throughout the years doi org 10 37626 ga9783959872188 0 050 first page 273 last page 276 abstract too often teachers use the word trick in their mathematics lessons there are no tricks in mathematics but there are explanations for what appears to be a trick throughout this paper we will address this history of magic including the history of playing cards aradhana kumari do not teach the symbols in mathematics teach the meaning of the symbols doi org 10 37626 ga9783959872188 0 051 first page 277 last page 282 abstract unnecessary use of symbols in introducing ideas in mathematics makes it difficult to learn from a student s perspective these symbols are the hurdle for them to understand the concepts ideas in mathematics one example is when we ask students the following what is the meaning of the square root of a number often their reply is the symbol this shows that they did not understand the actual meaning of the square root of a number which is the number raised to power one half i will present many examples and show how we can avoid using unnecessary symbols and teach the ideas and concepts in mathematics sebastian kuntze marita friesen jens krummenauer karen skilling ceneida fernandez pere ivars salvador llinares libuše samkova lulu healy support for mathematics teachers through representations of practice

vignette based approaches in the project coreflect maths doi org 10 37626 ga9783959872188 0 052 first page 283 last page 288 abstract teachers analysis of vignettes can be a key for connecting specific classroom situations with mathematics education theories as vignettes are representations of practice with relevance for professional requirements of the mathematics classroom vignettes also represent or portray meaningful theoretical elements the use of vignettes in pre service and in service teacher professional development needs however conceptual and evidencebased exploration building on prior work with video text and cartoon vignettes the project coreflect maths aims at exploring the potentials of vignette based work both for supporting professional learning and for research into aspects of mathematics teachers expertise key aspects of the project work will be presented barbara h leitherer pankaj r dwarka entela k xhane jignasa r rami undergraduate research in a 2 year college climate change global learning process and observations doi org 10 37626 ga9783959872188 0 053 first page 289 last page 294 abstract in order to thrive and be successful in an increasingly interconnected world 21st century students require multiple opportunities to engage with global learning landorf et al 2019 mathematics faculty guided 2 year college honors students in the us through an independent study analyzing real world global climate change data supplied by the world wildlife fund wwf this proposal will elaborate in depth about the undergraduate research process lessons learned and observations made presenters will reflect on strategies used to support both collaborative and independent learning how students increased their awareness of climate change as a global problem how this contributed to students ownership success and enhancement in undergraduate research leading to preparedness for further education and a successful career in science technology

engineering and mathematics hadas levi gamlieli alon pinto boris koichu secondary tertiary transition and effective ways of coping with it a perspective of lecturers doi org 10 37626 ga9783959872188 0 054 first page 295 last page 300 abstract the secondary tertiary transition stt in mathematics education is a longstanding concern this study explores university mathematics lecturers perspectives on the challenges underlying stt and on the effectiveness of university level coping measures currently employed the analysis of 311 responses to an international survey suggests that there is considerable variability regarding the prevalent perspectives on stt among university lecturers while most respondents recognized school related factors the coping measures they recommended were mainly university related the findings stress the need to improve communication both between university mathematics lecturers and the school mathematics education community and across universities for promoting comprehensive initiatives to address stt sigal levy yelena stukalin introducing main statistical concepts to non statisticians doi org 10 37626 ga9783959872188 0 055 first page 301 last page 303 abstract in this paper we present and discuss the results of an academic open end mid term statistics exam given to high school teachers qualifying to teach mathematics at a matriculation exam level the exam focused mainly on defining and understanding key terms and concepts in statistical inference the purpose of this study is to identify what questions would be good predictors of the overall score thus indicating a good understanding of statistics item analysis showed that the ability to properly define a parameter state research hypotheses and interpret the findings were more inclined to do well in the exam keywords statistical concepts teaching statistics non statisticians nicole lewis ryan andrew nivens jamie price jennifer price anant godbole pandemic driven

mathematical initiatives within the east tennessee state university center of stem education doi org 10 37626 ga9783959872188 0 056 first page 304 last page 309 abstract we describe three mathematics education initiatives launched as a result of the global pandemic i the eastman funded mathelites professional development pd program for k 8 teachers was offered online teachers were vastly more involved due to their greater autonomy old outcomes and those from 2020 will be compared ii etsu s governor s school which offers high school students statistics and biology college courses went online too and we used columbia university virology lessons and covid19 data sets to make the courses more engaging to students student projects were assessed to be of a higher quality than in years past iii with niswonger foundation support we have launched a pd thrust for teachers in 2021 in the new areas of epidemiology artificial intelligence and statistics with r po hung liu students perceptions of paradoxes of the infinity doi org 10 37626 ga9783959872188 0 057 first page 310 last page 315 abstract infinity is a significant element for understanding calculus yet studies consistently suggest that its counter intuitive nature confused college students the purpose of this study was to investigate taiwanese college students perceptions of paradoxes of the infinity and observe how their perspectives shifted back and forth while facing contradictory facts it was found the 1 1 correspondence was the most used criterion for comparing the cardinality of infinite sets which is somewhat different from previous studies and students reasoning on zeno s paradoxes was feeble the study suggests future research of this line should pay attention to the dialectical process of students discourse to detect their core beliefs about the infinity hong lu xin chen the relationship between teacher student relationship interest self efficacy and mathematics achievement does gender play a role in it doi org 10 37626 ga9783959872188 0

058 first page 316 last page 321 abstract this study compared the mechanism by which the teacher student relationship tsr affects mathematics achievement in different gender groups through interest and self efficacy in mathematics the results suggest that 1 in both samples tsr positively predicted interest and self efficacy interest positively predicted self efficacy and self efficacy in turn positively predicted mathematics achievement 2 gender differences were also detected the positive relationships of tsr to self efficacy and interest to self efficacy were stronger among the male than the female students overall the findings confirm that tsr have an important influence on chinese students mathematics academic motivation and achievement and that gender differences affect the patterns of these relationships possible explanations for the results and practical implications are discussed key words teacherstudent relationship interest self efficacy mathematics achievement crossgender comparison cheryl ann lubinski allison kroesch developing not teaching problem solving strategies doi org 10 37626 ga9783959872188 0 059 first page 322 last page 324 abstract many teachers use explicit instruction to teach students how to solve a problem and then have their students practice a specific strategy research indicates this type of teaching does not necessarily improve problem solving skills students need to solve problems using their intuitive strategies which might include pictures and concrete materials for a specific problem we will share the strategies used by students in the united states 17 year old brothers and their family in poland and teachers of students ages 5 17 in zimbabwe findings indicate that most people do not choose a picture strategy but a trial and error strategy using symbols most are unsuccessful at solving the problem we will share teaching strategies that encourage developing not teaching problem solving strategies jürgen maaß professional

mathematical modelling what we can learn about teaching real world mathematics from the real application of mathematics in our world doi org 10 37626 ga9783959872188 0 060 first page 325 last page 330 abstract lessons more motivation and a more sustainable learning success professional mathematical modelling is an important foundation for modern technology based societies we are all significantly influenced by the results of mathematical modelling the decisions for lock down masks and travel restrictions in connection with corona are a current example this article drafts what we as teachers researchers can learn about successful mathematical modelling from professional working mathematicians who are using applying mathematics in the natural sciences technology development medicine economics social and humanities research practice consultancy for politics the financial world other economic sectors the background for this article is my research on mathematics as a technology its acceptance as a concept and ways of technology transfer as well as decades of experience with colleagues from industrial mathematics indmath uni linz ac at and the risc jku at institutfuer symbolisches rechnen risc anwendungen risc software gmbh who started their work here in linz a long time ago as a co founder and co organizer i organized and enjoyed many lectures on mathematics and society industrial mathematics etc at the johannes kepler symposium numa unilinz ac at jks 2020 jodelle s w magner susan mcmillen making word problems accessible to all innovating through meaningful models doi org 10 37626 ga9783959872188 0 061 first page 331 last page 332 abstract working with a large urban district over 14 years of mathematics science partnership msp grants over 500 teachers of mathematics special education teachers mathematics coaches and administrators have come together to create engaging mathematics within grade 3 through 12 classrooms workshop

participants will engage with an innovative use of a mathematical model and learn how it makes mathematics more accessible to students at all levels especially to english language learners workshop participants will experience the use of the model in a variety of problem solving contexts obstacles to teachers adopting these materials to use within their instruction and strategies used to overcome these challenges will be discussed rafael alberto méndez romero maría angélica suavita ramírez the minnga labs an initiative of the universidad del rosario to strengthen stem skills social sensitivity and youth empowerment in colombia doi org 10 37626 ga9783959872188 0 062 first page 333 last page 337 abstract the challenge of educating the generation of the digital age leads us to resort to pedagogical innovations that are sensitive empathetic analytical and multidisciplinary in nature additionally these new student communities are characterized by appropriating causes mobilize manifest and are genuinely curious which confronts us as educators with a greater and fascinating challenge on the other hand the historical moment of colombia forces us to seek the unity of the country and generate a sum of forces from the specific talents of the people in the regions to solve as a body the emerging needs of the moment in this article we show a technological pedagogical innovation designed at the universidad del rosario which is based on strengthening stem skills and youth empowerment through the use of our minnga labs a version of a living laboratory as a social an open innovation jennifer missen a process for updating mathematics teaching for 21st century students doi org 10 37626 ga9783959872188 0 063 first page 338 last page 343 abstract it is inevitable and necessary that the curriculum pedagogy and school and classroom structures for the teaching of mathematics will continue to change over the next 30 years however teachers are time poor there are more and more who are

teaching mathematics when it is not their primary content area and who may have knowledge of mathematics but not the current pedagogical knowledge early career teachers need support in building a portfolio of tools and resources that work for them and their students experienced traditional teachers are more comfortable with direct teaching and mastery practice and understandably are resistant to change inquiry based teaching and collaborative strategies differentiated and tailored for the class and its individuals combined with direct teaching and mastery practice allow for greater equity and increased preparation of students for the ever changing workforce this two part workshop has participants work through the process of transitioning existing traditional or textbook units of work to flexible differentiated units with enough detail and resources to support any teacher to walk into the classroom knowing that they will serve all the students well shelby morge christopher gordon using squeak etoys to model mathematical ideas doi org 10 37626 ga9783959872188 0 064 first page 344 last page 349 abstract effective mathematics instruction involves students in making sense of mathematical ideas and reasoning mathematically nctm 2014 unfortunately for many us students in grades 6 8 ages 10 14 mathematics is a repeat of topics learned in elementary school with an emphasis on computation for this reason students start to see mathematics as something that is hard to understand and not enjoyable in this workshop we share how a technology tool squeak etoys was used in a lesson to engage grade 6 8 students in discovering the relationship between the number of sides and the angle measure in regular polygons we describe a lesson implementation and engage participants in the development of a squeak etoys computer model in addition conclusions related to mathematics instructional practices are shared key words squeak etoys modeling problem solving lesson

geometry polygons janina morska new methods and forms of work during online maths lessons doi org 10 37626 ga9783959872188 0 065 first page 350 last page 353 abstract in more than 38 years as a mathematics teacher i have always tried to look for interesting methods and new forms of work i wondered how to explain the new material to students so that they would understand and be able to use the information in the future the previous school year has been a huge challenge in the field of distance learning from october 2020 to may 2021 all teachers in poland conducted online lessons as a result we had to switch from traditional classroom teaching to online teaching so i decided to look for appropriate tools and solutions of how to conduct such lessons keywords online learning distance learning applications computer programs teaching materials virtual notes it tools online mathematics patricia s moyer packenham relationships among semiotic representational transformations and math outcomes in digital games doi org 10 37626 ga9783959872188 0 066 first page 354 last page 354 svenja müller anna fath streb risk literacy in the context of stochastics and mathematical education doi org 10 37626 ga9783959872188 0 067 first page 355 last page 360 abstract the purpose of this risk literacy study was to explore the ways of integrating examples of global challenges into mathematics education the examples follow an approach to introduce risk literacy in teacher education along with a curriculum analysis for secondary education in germany to include risk literacy within the given requirements and constraints two main examples microplastic pollution and extreme events due to climate change are analysed in the interdisciplinary context of global challenges and their understanding of mathematical knowledge for teaching and learning stochastics m estela navarro robles elementary teachers reaching a quasi complete knowledge of rational numbers through an online course doi org 10

37626 ga9783959872188 0 068 first page 361 last page 366 abstract there is evidence that most of the elementary teachers in mexico have various conceptual deficiencies in their knowledge about rational numbers however the deficiencies were not the same in all the cases so we decided to design a non traditional personalized online course constructed as an adaptative system in which it was identified if the participant covered each one of the different conceptual approaches in various contexts when it was identified that a conceptual approach was not covered interactive materials and videos were presented to them that allowed them to understand what they had not covered the aim of the course is to enable teachers to reach a quasicomplete conceptualization whose meaning for us it is to understand the topic from different conceptual approaches in a deep way this paper presents the structure of one module of the course one detailed example and results of the pilot test of this module benita p nel noticing through self reflection by mathematics teachers using video stimulated recall doi org 10 37626 ga9783959872188 0 069 first page 367 last page 372 abstract continuous professional development should be navigated in a teacher s own context addressing their particular needs where timeous feedback can be of great benefit however the major teachers union in south africa hindered government officials to enter the classroom limiting support most professional development pd initiatives are thus off site and not always customised to the needs of the individual teacher in this study the use of video stimulated recall vsr was used as a pd tool where self reflection is foregrounded reporting on one teacher the research question was what did the teachers notice and act upon when vsr was incorporated as a pd amongst mathematics teachers through mason s discipline of noticing the teacher s noticing was investigated key words video stimulated recall mathematics education continuous professional development

teacher noticing in house setting zanele ngcobo evoking school mathematical knowledge among preservice secondary mathematics teachers through error analysis doi org 10 37626 ga9783959872188 0 070 first page 373 last page 373 abstract this article explores how attention to specialised content knowledge sck could evoke the development of school mathematics concepts among pre service mathematics teachers psmts at the heart of the repeated debate about the delivery of professional mathematics teacher education curricula has been the reported lack of development of psmts knowledge for teaching however discussion of what mathematical knowledge for teaching is needed by psmts and how it should be developed had been uneven in south africa attention to improving the status quo of learners poor performances in mathematics has been directed toward improving in service teachers mathematical knowledge for teaching however research has shown that the problem does not only emerge when teachers become practitioners the problem of low levels performance and of understanding of school mathematics by pre service teachers has been identified by many studies but is often not addressed during teacher training this article explores an under examined strategy for addressing the repeated concerns about the quality of pre service mathematics teachers education it examines how attention to specialised content knowledge sck within a preservice teacher education curriculum could potentially influence deeper quality mathematical knowledge to pre service mathematics teachers professionality this is a qualitative study conducted in 2018 and 2019 data was generated from n 61 psmts that were enrolled for bachelor of education majoring in mathematics data was conducted using written task open ended questionnaires and focus group interviews the findings from this small scale study showed that error analysis has the

potential to influence the development of smk furthermore findings suggest that attention to sck has the potential to evoke school mathematics concepts and the evolution of subject matter knowledge based on the findings it is recommended that future research should be conducted to determine the veracity of these conclusions and their generalization to other mathematical topics considering the suggestions made by in literature that the description of knowledge is only valid at the time of the investigation there is a need of large scale to ascertain the effect of error analysis toward the development of psmts smk of other school mathematics topics keywords error analysis pre service mathematics teachers specialised content knowledge jenna o dell todd frauenholtz recruiting mathematics and mathematics education majors to a university doi org 10 37626 ga9783959872188 0 071 first page 374 last page 377 abstract this paper will present strategies used to recruit students to a four year university to complete a double major in mathematics and mathematics education then enter the teaching field the recruiters are two professors who work in both the mathematics and education departments at a university in the united states the mathematics department has been especially supportive of the initiative as it will double the number of mathematics majors in their programs for two years from four to nine students the recruiting included contacting community colleges professional organizations word of mouth the university marketing department and visits to collegiate mathematics classrooms at the level of calculus and above this project was supported by the national science foundation nsf as a noyce project and will support students financially with full cost of attendance for the final two years of the four year program elizabeth oldham aibhín bray undergraduate mathematics students reflections on school mathematics curricula after a major curriculum change in ireland doi org 10 37626

ga9783959872188 0 072 first page 378 last page 383 abstract after decades in which the irish post primary grades 7 12 mathematics curriculum changed incrementally a major innovation project was approved in 2008 and a reform type curriculum was phased in over several years the project was controversial and some students developed negative attitudes to the change this paper examines recent students opinions in particular the opinions of mathematics undergraduates who had experienced the transition and who took a mathematics education module at one irish university in 2019 20 they studied old and new curriculum documents and examination papers and watched videos of reform type lessons their reflective comments were posted to a discussion board thematic analysis of posts from the 18 out of 25 students who gave permission for use of their work in research indicates that by then these students supported many aspects of the reformed curriculum nick vincent otuma mismatch between spoken language and visual representation of mathematical concepts doi org 10 37626 ga9783959872188 0 073 first page 384 last page 388 abstract this paper examines secondary students mismatch in meaning between spoken language and visual representation of mathematical concept of a rightangled triangle forty eight students age 16 17years participated in the case study students were asked to select plane figures that matched the descriptions given on each questionnaire item in group interview participants were asked to give properties of selected plane figures and draw a diagram representing the same plane figures the results of this research suggested that many students had similar imperfect conception of a right angled triangle keywords mathematical language conceptual understanding jenny pange alina degteva project based learning in statistics doi org 10 37626 ga9783959872188 0 074 first page 389 last page 394 abstract online teaching process is triggered

by the covid 19 and project based learning pbl goes through a new stage of development as it includes ict tools and up to date teaching methods we applied this approach in an online undergraduate course in statistics this paper describes the process and evaluates the outcome of pbl in teaching statistics course to a group of undergraduate students at the university of ioannina greece students had to attend the class and react to practical exercises according to the demands of the pbl they were asked to use questionnaires and go through interviews to evaluate the teacher to student student to student and student to content interactions in pbl method data obtained from online questionnaire and were analysed the results implied high level of interactions during pbl in statistics key words project based learning statistics ict tools interaction andrea peter koop school readiness in mathematics development of a screening test for children starting school doi org 10 37626 ga9783959872188 0 075 first page 395 last page 400 abstract the study reported in this paper involved the development of a screening test to be applied by teachers with the whole class at school entry the goal of this screening instrument is the identification of children who are at risk with respect to their school mathematics learning and therefore need immediate support and intervention the paper reports the results of a study with 1757 children from 97 grade 1 classes in 39 primary schools in germany that have been tested with the new screening one month after starting school maria piccione francesca ricci the importance of early developing symbol sense doi org 10 37626 ga9783959872188 0 076 first page 401 last page 406 abstract in this paper we deal with the mathematical objects symbolic representation as a relevant educational problem in particular we refer to the semiotic approach a teaching model caring the distinction among sign meaning sense proposing its adoption since the very beginning of the school experience focusing on the

development of symbol sense means sharing relational learning principles reconsidering usual instrumental learning ways we aim at promoting students awareness in managing mathematical language taking into account its widespread weakness also shown by our investigation awareness is a powerful mental attitude which enables facing difficulties and generating a proper conception of what mathematics and doing mathematics really are then enhancing affect maria piccione francesca ricci activities and tools for early developing symbol sense doi org 10 37626 ga9783959872188 0 077 first page 407 last page 412 abstract this work deals with practical aspects of semiotic and relational approaches in teaching learning it is based on the early algebra principle by which mental models of algebraic thought can be constructed starting with primary school by teaching arithmetic algebraically here the problem of the symbolic representation of mathematical objects is tackled the aim is to allow students to clearly distinguish between the two worlds the one of signs and the one of meanings and to use signs of mathematical language with full awareness rather than just manipulating them we present activities and tools which take into consideration different semiotic fields gestural iconic natural to achieve the mathematical field shelley b poole the yes and approach to teaching mathematical modelling doi org 10 37626 ga9783959872188 0 078 first page 413 last page 417 abstract mathematical modelling can be a particularly creative tool when students are asked to solve open ended problems as instructors when implementing mathematical modelling in the classroom we can build on the ideas of our students utilizing the concept of yes and from improvisational theatre we can foster students creativity and empower them to take ownership of the mathematics when solving open ended problems using this approach allows us an opportunity to let go of the structure of old and

embrace new approaches and ideas in the classroom jordan t register christian h andersson analysing psts ethical reasoning in a data driven world doi org 10 37626 ga9783959872188 0 079 first page 418 last page 423 abstract the prevalence of big data analytics as a proxy for human decision making processes in globalized society has catalyzed a call for the modernization of the mathematics curriculum to promote data literacy and ethical reasoning to support this initiative ten preservice mathematics teachers psts in sweden swe and the united states us were interviewed to identify what ethical considerations preservice teachers psts make in their mathematical analyses of data science contexts preliminary results indicate that teachers make a myriad of ethical considerations in their mathematical work that are tied to their critical mathematics consciousness cmc conceptions of data literacy and experiences as a result it is imperative that educators simultaneously design educational curricula to foster students cmc and work to transform teacher held definitions of data literacy to reflect changes brought on by globalization sarah a roberts cameron dexter torti julie a bianchini a mathematics specialist supporting district shifts in instruction for multilingual learners through studio days doi org 10 37626 ga9783959872188 0 080 first page 424 last page 428 abstract mathematics specialists fill a gap in providing individualized professional learning for classroom teachers including furnishing much needed professional learning related to multilingual learners this qualitative study examines the role a secondary district mathematics specialist in the united states played in supporting shifts in instruction for multilingual learners through the enactment of studio days professional learning interviews across two years with a mathematics specialist were examined using a framework of multilingual learner principles and adaptive reasoning we share instructional shifts around

the adaptive reasoning categories of flexibility understanding and deliberate practice as related to multilingual learners we conclude with implications for both research and practice related to secondary mathematics specialists multilingual mathematics instruction and studio day professional learning keith robins applying mathematical thinking principles to real life situations to create an objective thinking strategy doi org 10 37626 ga9783959872188 0 081 first page 429 last page 433 abstract teaching set thinking can make a great difference in teaching and learning mathematics as it demonstrates its relevance to real life the following examples include how socialising is a mathematical process and how one can create a mathematical model for any experience or system rather than creating perceptions christine robinson karen singer freeman digital enhancements for common online mathematics courses doi org 10 37626 ga9783959872188 0 082 first page 434 last page 438 abstract the university of north carolina system office unc system established the digital enhancement project to rapidly develop high quality online course materials to support faculty and student success in online courses content was created for calculus i a course that is critical to student progress is in high demand and has large enrollments to evaluate the usefulness and impact of the materials project evaluators developed assessment instruments that included a survey for students enrolled in classes being taught by early adopters overall students rated the quality of classes using project materials to be high however underrepresented ethnic minority students were somewhat less positive than other students and all students were less positive about the alignment of course content with course assessments than they were about other aspects of the course design ann sofi röj lindberg trends in mathematics education in finland doi org 10 37626 ga9783959872188 0 083 first page 439 last page 444 abstract since

pisa 2000 there has been a huge international interest towards education in finland are there particular explanations to the pisa success a philosophers stone to be found is it possible to export innovative components found in finnish schools to other countries and what exactly are these components is it about accessibility can the successful components be noticed and described and why has the finnish pisa results in mathematics dropped lately questions like these have been asked over the years in the paper i discuss trends in the finnish public schooling that i find to be of particular importance and highlight changes in the curriculum and trends in mathematics education generally i connect my arguments to research findings as well as to anecdotal stories sheena rughubar reddy emma engers video tutorials and quick response codes to assist mathematical literacy students in a non classroom environment doi org 10 37626 ga9783959872188 0 084 first page 445 last page 450 abstract this paper discusses effectiveness of video tutorials accessed via quick response codes on grade 10 mathematical literacy students ability to complete their homework to assist them outside of the classroom an intervention involving video tutorials explaining specific sections of work and how to go about solving problems was devised students could access the relevant tutorials on a mobile device via the scanning of barcodes provided on the worksheets the effectiveness of the intervention was assessed both quantitatively and qualitatively through analysis of the participating students homework submissions and interviews with the students after the intervention had ended feedback from students via focus group interviews and questionnaires revealed that they found the tutorials helpful this would indicate that the intervention was potentially beneficial keywords quick response codes video tutorials homework sheryl j rushton melina alexander shirley dawson mathematics to teacher education persistence doi org 10 37626

ga9783959872188 0 085 first page 451 last page 456 abstract in 2017 a university in northern utah s teacher education and mathematics departments moved from a two course mathematics requirement to incorporate a three course mathematics requirement for elementary and special education teacher education majors to satisfy university and utah state board of education quantitative literacy graduation requirements the proposed research seeks to determine how persistence rates differ from the original two course math series to the new three course destination series robyn ruttenberg rozen in the moment narratives interventions with learners experiencing mathematics difficulties doi org 10 37626 ga9783959872188 0 086 first page 457 last page 462 abstract despite a significant amount of planning so much of what occurs in mathematics teaching and learning intervention interactions for both teacher and learner are based on fleeting in the moment decisions and responses at the root of these in the moment interactions are narratives that position the learner teacher and mathematics in this paper i explore the interplay between in the moment decisions and responses narratives and positioning within a mathematical intervention for a learner experiencing mathematics difficulties i use data from a mathematics intervention study of learners experiencing mathematics difficulties to show that interventions in mathematics can be a reciprocal and partnered activity importantly since these narratives emerge in the reciprocal space of an intervention narratives also evolve through the interaction tanishq kumar sah extension of theories doi org 10 37626 ga9783959872188 0 087 first page 463 last page 465 abstract from an atom to this universe from a bowl of water to the cosmic ocean this constant is present everywhere this constant is π periodicity of the tangent function for tangent function we know that tan tan 1 x x but the expression tan ntan 1 x looks very complicated but is actually an

expression of the type polynomial divided by another polynomial the sine function is very important not only for graphs but for geometry too there are some inputs whose behavior is very strange from the usual ones geometrical shapes and their relations are very important for many thing such as for vectors and many more but the triangle is very special because it is the least sided polygon riemann zeta function is very crucial for prime numbers infinite series related to them may be a game changer for it wallis s integral formula is a boon but its domain is very constrained and needs another solution to it ishola a salami temitope o ajani mathematics songs to hip hop music power to engage pupils and improve learning outcomes in primary mathematics doi org 10 37626 ga9783959872188 0 088 first page 466 last page 471 abstract song based strategy has been one of the most effective approaches of making learners remembering rule governed educational contents like that of mathematics but the extent to which learners enjoy mathematics songs and get engaged in it within and outside the school system is limited besides many of the available mathematics songs are for preschool while research studies have shown that learners scores in mathematics started to decline from primary iv class one of the music types children love most is hip hop and they easily memorize the lyrics this led to the production of mathematics hip hop music with its lyrics being mathematics principles ideas formulae and procedures for upper primary classes this study determines the effectiveness of mathematics hip hop music on improved mathematics learning outcomes keywords hip hop music matmusic upper primary mathematics s r santhanam teaching mathematics using storytelling and technology doi org 10 37626 ga9783959872188 0 089 first page 472 last page 475 abstract storytelling coupled with technology is an attractive method to teach geometry the following story was told to a set of students of

the age group 14 16 years who are familiar with the geogebra software a pirate hid his treasures in an island and left a note for the treasure hunt to his son the instructions are as follows find two palm trees in the island with markings of a heart on them there will be a very small pond near them from the pond go to one palm tree and turn 90 degrees and proceed equal distance to mark a point p on the ground do the same for the second palm tree to get another point q the treasure is hidden at the midpoint of pq when his son went there he could find the two palm trees but there was no pond nearby but with his geometric knowledge he could find the treasure how the students tried and some found the solution in this short paper this is discussed ipek saralar aras betul esen designing lessons for the 5th graders through a design study on teaching polygons doi org 10 37626 ga9783959872188 0 090 first page 476 last page 481 abstract it has been argued by researchers that learning about polygons is important student performance on polygons particularly at the middle school level was found to be lower than expected thus this paper presents brief summaries of reta based lesson plans on polygons the reta is a maths model which supports realistic exploratory technology enhanced and active lessons the participants of the study were 60 middle school students data was collected through lesson recordings of 5 lessons pre tests and post tests to measure students performance on polygons lesson evaluation forms and interviews the findings show that students found the reta based lessons engaging but some of the parts were difficult for them the lesson plans presented in this paper were the 2nd version of the plans amended after the 1st cycle of designbased research it is hoped that the lesson plans set an example for teachers and teacher candidates stephanie sheehan braine irina lyublinskaya a framework for online problem based learning for mathematics educators doi org 10 37626 ga9783959872188 0 091 first page 482 last page

487 abstract research shows that problem based learning pbl has the capacity to make mathematics culturally relevant so there is a need to adapt this successful learning model to virtual environments this study proposes the framework for online problem based learning for educators onpbl e to add this challenge the content components of the onpbl e framework were developed by unpacking pbl instructional principles and identifying interactions between the essential elements of pbl the context the educator and the learner then the multimodal model for online education was used to identify online modules for these interactions this study also describes an example of implementing pbl in an online mathematics modeling course m vali siadat keystone model of teaching and learning in mathematics doi org 10 37626 ga9783959872188 0 092 first page 488 last page 493 introduction keystone model presents a holistic approach to math education at the college it is a dynamic system of frequently assessing student learning and adjusting teaching practices its philosophy is based on the belief that all students can learn mathematics provided they are engaged in the learning process keystone views classroom as a learning community where through peer to peer interaction and cooperation all students achieve contrary to other programs that put the students in competition with one another essentially pitting them against each other for grades our program challenges students to cooperate so that all attain the standards of excellence keystone is an alternative model to traditional educational practices and its basic principles should be applicable to all disciplines parmjit singh nurul akma md nasir teoh sian hoon the dearth of development in mathematical thinking among high school leavers doi org 10 37626 ga9783959872188 0 093 first page 494 last page 499 abstract the prime rationale of the high school math curriculum is to develop the intellectual mind of learners who can think and

apply learnt content into solving problems of different areas of learning thus to assess this context a mixedmethod approach was undertaken to assess the levels of the 640 high school leavers mathematical thinking acumen in the context of their preparation in facing the challenges of tertiary level the findings depict low level mathematical thinking attainment regarding their dearth in critical thinking and creative thinking to solve higher order thinking tasks they lack a heuristics repertoire to use their contextual knowledge in solving fundamental nonroutine problems this then begs the question how are these students to face the upcoming hurdles and challenges bound to be thrown their way at the tertiary level keywords mathematical thinking problem solving non routine heuristics praneetha singh mathovation creativity and innovation in the mathematics classroom doi org 10 37626 ga9783959872188 0 094 first page 500 last page 505 abstract the 21st century is predicted as the century of rapid development in all aspects of life people are creative but the degree of creativity is different solso 1995 the perspective of mathematical creative thinking expressed by experts such as gotoh 2004 and krulik and rudnick 1999 refer to a combination of logical and divergent thinking which is based on intuition but has a conscious aim and process this thinking is based on flexibility fluency and the uniqueness of mathematical problem solving this paper will aim to assist the readers to find out the competencies that are required to assess the creative thinking ability and characteristic of mathematical problems that can be used in creative thinking charles raymond smith cyril julie towards understanding integrating digital technologies in the mathematics classroom doi org 10 37626 ga9783959872188 0 095 first page 506 last page 511 abstract in the context of ict integration a presentation by a teacher during a continuing professional development session is analyzed from the instrumental orchestration as

well as the technological pedagogical and content knowledge tpack perspective the results indicate that some of the components of instrumental orchestration were used by the teacher during the presentation in realising these orchestrations the teacher had to delve into the different knowledge components that constitute tpack it is concluded that cpd providers need to take such complexities into account when delivering training programs keywords geogebra ict integration instrumental orchestration tpack mathematics teacher practices panagiotis stefanides generator polyhedron icosahedron non regular discovered invention doi org 10 37626 ga9783959872188 0 096 first page 512 last page 517 abstract the invented 2017 polyhedron is a non regular icosahedron it has 12 isosceli triangles and 8 equilateral ones its skeleton structure consists of 3 parallelogramme planes orthogonal to each other with sides ratios based on the square root of the golden number ratios of 4 π specially for π 4 t 3 14460551 where t is the square root of the golden number Φ equal to 1 27201965 and related directly to the icosahedron whose structure is based on the golden number and to the dodecahedron whose structure is based on the square of the golden number its geometry relates to plato s timaeus most beautiful triangle a proposed theorization by the author contra the standard usual international interpretations presented to various national and international conferences the magirus kepler one is a constituent part of this triangle similar to it but not the same with it michelle stephan david pugalee the future of mathematics education in the digital age doi org 10 37626 ga9783959872188 0 097 first page 518 last page 521 abstract how do the mathematics content and processes taught in school today need to change in order to prepare students for participation in the digital and information age we propose to stimulate a discussion about what mathematics education should aim for in

preparing students for employment and local global citizenship in this ever changing technological world our group will develop a forward minded agenda on implementation of mathematics content and practices this will include detailing 1 what content practices should be kept changed or deleted from the curriculum 2 potential impediments to teachers implementing them and possible strategies to address these and 3 necessary research projects to study implementations in order to make ongoing recommendations we will aim to start with middle school ages 12 15 with a vision to continue this working group through multiple conferences yelena stukalin sigal levy introducing probability theory to ultra orthodox jewish students by examples from the bible and ancient scripts doi org 10 37626 ga9783959872188 0 098 first page 522 last page 525 abstract cultural diversity in the classroom may motivate teachers to seek examples that reflect their students cultural backgrounds thus making the course material more appealing and understandable in this context the holy bible is a source of many stories and anecdotes that may be included in teaching probability theory to even ultra orthodox jews this paper aims to demonstrate the use of stories from the bible to introduce some concepts in probability we believe that this approach will make learning probability and statistics more understandable to the ultra orthodox students and increase their motivation to engage in their studies keywords cultural diversity biblical examples non statisticians emily k suh lisa hoffman alan zollman stem smart five essential life skills students need for their future doi org 10 37626 ga9783959872188 0 099 first page 526 last page 530 abstract to be successful in a future stem focused world students need to know more than content students need to be stem smart a stem smart student has the mindset of an intellectual risk taker the tenacity to tackle tough problems while learning from mistakes and the critical

thinking skills to separate scientific information from opinions and beliefs we use the smart acronym struggle mistakes all risk think to introduce five essential life skills not obviously related to stem science technology engineering and mathematics disciplines but necessary for success in stem for each of our five essential skills we provide an explanation of its importance connections to relevant educational research and real world applications janet hagemeyer tassell jessica hussung kylie bray darby tassell haley clayton carbone elementary pre service teachers beliefs about mathematics fluency transforming through readings discussions doi org 10 37626 ga9783959872188 0 100 first page 531 last page 536 abstract teacher candidates continue to enter elementary math methods with the belief that mathematics fluency is synonymous to speed and rote memorization assessed best by timed tests in the elementary math methods 2018 2021 school years fall and spring semesters qualitative data were gathered from pre service elementary mathematics teachers pre post assessments of reading mathematics fluency journal articles viewing video samples and participating in full class discussions the pre to post assessment themes show that reading research articles may be a possible intervention to add to their clinical school observations in the k 6 setting eleni tsami dimitra kouloumpou andreas rokopanos the gender gap in statistics courses a contemporary view on a statistics department doi org 10 37626 ga9783959872188 0 101 first page 537 last page 541 abstract gender equality remains a strategic objective of the eu educational system the present paper provides a contemporary view of the gender balance in the department of statistics and insurance science at the university of piraeus our results indicate that a gender gap is prevalent in this specific department although this gap is only marginal in terms of the statistics on students on the other hand statistics for the academic staff reveal that the

department is clearly male dominated thus stirring the discussion of gender preferences and systemic gender bias our findings support the notion that the institutional change currently taking place across departments and academic communities worldwide is yet to come to fruition and considerable effort is needed in order to bridge the gender gap in science technology engineering and mathematics stem courses ching yu tseng paul foster jake klinkert elizabeth adams corey clark eric c larson leanne ketterlin geller using cognitive walkthroughs to evaluate the students computational thinking during gameplay doi org 10 37626 ga9783959872188 0 102 first page 542 last page 547 abstract in this paper we describe how a team of multidisciplinary researchers including game designers computer scientists and learning scientists created a learning environment focused on computational thinking using a commercial video game minecraft the learning environment includes a minecraft mod a custom companion application and a learning management system integration the team designed the learning environment for students in grades 6 8 working with a group of educators the researchers identified eleven high priority computer science teacher association csta standards to guide game development the team decomposed the standards into essential knowledge skills and abilities in this study we describe how we used a cognitive walkthrough with a middle school student to investigate a the ways in which the game supports student learning b the barriers to learning and c the necessary changes to facilitate learning ariana stanca vacaretu growe in math doi org 10 37626 ga9783959872188 0 103 first page 548 last page 553 abstract getting readers on the wavelength of emotions growe is an erasmus project initiated with the aim to develop all including math teachers competences to address students literacy and emotional learning needs the growe classroom approach includes meaningful reading

and writing learning activities and develops mastery of such strategies using diverse authentic texts i e not clean textbook texts while learning the discipline simultaneously the students enhance their social emotional skills by learning to recognise and manage their emotions establish positive relationships and make responsible decisions this paper presents my experience in implementing the growe approach in my maths lessons with high school students the authentic texts i used and related tasks and some implementation results shin watanabe takako aoki in school and out school doi org 10 37626 ga9783959872188 0 104 first page 554 last page 559 abstract currently learning in developed countries is centred on school education it is not only japanese teachers who regret that few students enjoy learning mathematics under the current school system and in the age of 100 years of life everyone should continue to study academics even after graduating from school unfortunately learning mathematics is difficult after graduating from school it is clear that lifelong learning has now become an important learning venue for all i decided to call this school education in school and to be released from the school system and call learning out school i will describe the richness of the future of out school which is a place for learning in the future out school is an important mathematical education that is an extension of in school key words in school out school creativity mathematical learning laura watkins patrick kimani april ström bismark akoto dexter lim representational competence with linear functions a glimpse into the community college algebra classroom doi org 10 37626 ga9783959872188 0 105 first page 560 last page 565 abstract teaching and learning strategies that encourage students to develop the ability to use mathematical representations in meaningful ways are powerful tools for building algebraic understandings of mathematics and solving problems american

mathematical association of two year colleges amatyc 2018 the study of functions in algebra courses taught at community colleges in the united states provides students the opportunity and space to make connections between important characteristics of various families of functions using examples of teaching and learning linear functions from intermediate and college algebra courses in community colleges we explore the ways instructors and students use a variety of representations visual symbolic numeric contextual verbal and or physical in teaching and learning linear functions while connecting between and within these representations ian willson formative assessment activities for introductory calculus doi org 10 37626 ga9783959872188 0 106 first page 566 last page 568 abstract a hands on workshop in which participants engage as beginning learners in an extensive range of stand alone tasks and in which some of the tenets and guiding principles of formative assessment are used to highlight what many consider to be the best kind of teaching practice and that which is critically important if we are to improve the quality of instruction for all the idea is that clear articulation of just what is meant by formative assessment is provided in the actual context of ready to use classroom tasks kay a wohlhuter mary b swarthout number talks working to deepen and grow number sense knowledge doi org 10 37626 ga9783959872188 0 107 first page 569 last page 573 abstract deep flexible number understandings are foundational for mathematics learning this workshop is based on two mathematics teacher educators journey to better understand how to facilitate future teachers development and use of number sense engaging preservice teachers in number talks enabled the educators to identify and to examine the strategies preservice teachers used during number talks while also providing a context for improving and expanding their own professional knowledge about number sense participant

engagement includes experiencing number talks examining preservice teachers work samples and responding to the educators observations about number sense language decomposition of numbers fluency and flexibility with numbers and mathematical properties ryan g zonnefeld valorie l zonnefeld rural stem teachers an oasis in the desert doi org 10 37626 ga9783959872188 0 108 first page 574 last page 579 abstract teacher preparation programs for stem education should prepare teachers for all settings including rural schools students across geographic locales show equal interest in stem fields but rural students often lack access to highly qualified stem teachers unesco 2014 notes that the disparity in education between rural and urban schools is a concern of many countries in the united states the national center for educational statistics confirms that twenty percent of students are educated in rural schools and the stem teachers in these schools are often the only stem expert these teachers become backbone teachers that set the foundation and direction of stem education in the entire school this paper reviews the landscape of stem education in rural schools explores strategies for ensuring high quality stem education in rural schools and outlines early successes of a university teacher preparation program in meeting these needs valorie l zonnefeld pedagogies that foster a growth mindset towards mathematics doi org 10 37626 ga9783959872188 0 109 first page 580 last page 584 abstract research demonstrates that a student s mindset plays an important role in achievement and that mindsets are domain specific carol dweck claimed that mathematics needs a mindset makeover and has shown that teachers can foster a growth mindset through their pedagogical choices this paper shares how one university trains preservice teachers in mathematics pedagogies that are key to fostering a growth mindset these practices include educating students on brain function

equitable access metacognition strategies feedback practices the importance of productive struggle and learning from mistakes magic squares are a great way for kids to practice addition combined with logical thinking this magic square is a variation in the normal puzzle the sums around the grid are always 15 but that limits the number of magic puzzles you can make with this game the sums are not always 15 how does the magic square works you have to write in every square a unique number for a 3 x 3 grid you must use the numbers from 1 to 9 and for 4 x 4 grid the numbers 1 to 16 the sum of the numbers in the rows columns and the diagonal must be the same as the numbers are printed around the puzzle remember you can only use every number once in the puzzle welcome to this fantastic collection of 100 magic square puzzles looking for a brain teasing challenge look no further magic squares provide two key pieces of information for every puzzle the sum of the numbers in each row column and the two diagonals and secondly the range of numbers that will feature so 15 30 for example with this information you must completely fill the grid using the numbers already given in place can you complete all 100 if you get a little stuck along the way solutions are featured towards the back of the book so take a peek there all of our puzzle books are printed on very high quality paper perfect for notes and scribbles for other puzzle books visit us at puzzle book co uk free with main text this book is intended for people that have bought the main edition by krantz techniques of problem solving with assistance from krantz steven g this guide to enabling middle grade mathematics teachers to use microsoft excel in the classroom focuses primarily on concepts taught in grades 4 10 with some pre algebra lessons for higher grades including files available for downloading to create custom math worksheets build self grading interactive spreadsheets and use excel to demonstrate charts and cartesian math this

handbook provides fun examples of probability solving equations magic squares and compound interest the puzzles in this book are based on 5 by 5 pandiagonal magic squares a pandiagonal magic square has 20 sums to the same number each row each column each of 5 downward diagonals and each of 5 upward diagonals sum to the same number called the magic sum the four following charts show the 5 rows the 5 columns the 5 downward diagonals and the 5 upward diagonals the rows columns and diagonals will be illustrated using the following magic square incidentally all entries in this magic square are prime integers 5 103 16067 19 1493 17 1489 17 101 16063 113 16061 13 1487 13 1483 11 109 16073 1116069 23 1481 7 107the 5 rows 1 1 1 1 12 2 2 2 23 3 3 3 34 4 4 4 45 5 5 5 5the top row sum is 5 103 16067 19 1493 17687 the second row sum is 17 1489 17 101 16063 17687 the third row sum is 113 16061 13 1487 13 17687 the fourth row sum is 1483 11 109 16073 11 17687 the fifth row sum is 16069 23 1481 7 107 17687 5 103 16067 19 1493 17 1489 17 101 16063 113 16061 13 1487 13 1483 11 109 16073 11 16069 23 1481 7 107the 5 columns 1 2 3 4 51 2 3 4 51 2 3 4 51 2 3 4 51 2 3 4 5the first column sum is 5 17 113 1483 16069 17687 the second column sum is 103 1489 16061 11 23 17687 the third column sum is 16067 17 13 109 1481 17687 the fourth column sum is 19 101 1487 16073 7 17687 the fifth column sum is 1493 16063 13 11 107 17687 four of the downward diagonals and four of the upward diagonals are broken diagonals they wrap around the edges of the square as shown in the following two diagrams 5 103 16067 19 1493 17 1489 17 101 16063 113 16061 13 1487 13 1483 11 109 16073 1116069 23 1481 7 107the 5 downward diagonals1 2 3 4 55 1 2 3 44 5 1 2 33 4 5 1 22 3 4 5 1the first downward diagonal sum is 5 1489 13 16073 107 17687 the second downward diagonal sum is 103 17 1487 11 16069 17687 the third downward diagonal sum is 16067 101 13 1483 23 17687 the fourth

downward diagonal sum is 19 16063 113 11 1481 17687 the fifth downward diagonal sum is 1493 17 16061 109 7 5 103 16067 19 1493 17 1489 17 101 16063 113 16061 13 1487 13 1483 11 109 16073 11 16069 23 1481 7 107the 5 upward diagonals5 4 3 2 14 3 2 1 53 2 1 5 42 1 5 4 31 5 4 3 2the first upward diagonal sum is 16069 11 13 101 1493 17687 the second upward diagonal sum is 1483 16061 17 19 107 17687 the third upward diagonal sum is 113 1489 16067 19 1493 17687 the fourth upward diagonal sum is 17 103 1481 16073 13 17687 the fifth upward diagonal sum is 5 23 109 1487 16063 17687 each puzzle has from 10 to 15 of the solution entries marked out your task is to fill in the marked out numbers to recreate the magic square that has only prime number entries patterns explore unusual number relationships series and sequences and squares and square roots puzzles include mystery numbers number tricks secret numbers and cross math puzzles problems set in interesting situations have students apply strategies and use calculators appropriately to find solutions discusses the mathematics of the chessboard and its problems focusing on its history the knight s tour problem magic squares domination other variations and independence a time to gather stones is a companion book to the author s earlier novel one man s war the latter was the story of a young man caught up in the great war of 1918 this is a continuation of his life but told from the eyes of the sweetheart who wrote him so faithfully and became his wife it is basically an account of a young woman faced with a widening world the 1920 s and 1930 s change the role of women forever and lindy jones moved with it a person of inner strenghth amd a fierce determination she took up her role as a small town wife and mother a support to her husband and his career as a newspaper publisher and a leader among her peers when her life reaches a time of crisis at the end she meets the challenge head on what is a magic square puzzle these

magic square puzzles in this book consists of 25 rectangles built as a 5x5 rectangle shape in 1989 widdis and richter proposed a composition theorem for magic squares which when combined with the de la loubere s method gives a method to generate large odd or even order magic squares from smaller magic squares this book includes but is not limited to 1 a discussion of the composition theorem for magic squares 2 discussion of the system of congruences algorithm for constructing magic squares 3 illustration of how a simple spreadsheet can be used to facilitate the computations of large magic squares using the congruence algorithms and the composition theorem and 4 discussion of kronecker sums kronecker products and a solution to the magic equation my yn s where m n and s are magic matrices the discussions and the examples are simplified and the book is designed to provide supplemental materials for a course in number theory for teachers or for a workshop in mathematics for teachers the contents could also be of interests to those who read mathematics recreationally magic squares are a great way for kids to practice addition combined with logical thinking this magic square is a variation in the normal puzzle the sums around the grid are always 15 but that limits the number of magic puzzles you can make with this game the sums are not always 15 how does the magic square works you have to write in every square a unique number for a 3 x 3 grid you must use the numbers from 1 to 9 and for 4 x 4 grid the numbers 1 to 16 the sum of the numbers in the rows columns and the diagonal must be the same as the numbers are printed around the puzzle remember you can only use every number once in the puzzle these panmagic square puzzles in this book consists of 25 rectangles built as a 5x5 rectangle shape a panmagic square pandiagonal magic square diabolic square diabolical square or diabolical magic square is a magic square with the additional property that the broken diagonals i e

the diagonals that wrap round at the edges of the square also add up to the magic constant these pan magic square puzzles in this book consists of 25 rectangles built as a 5x5 rectangle shape a panmagic square pandiagonal magic square diabolic square diabolical square or diabolical magic square is a magic square with the additional property that the broken diagonals i e the diagonals that wrap round at the edges of the square also add up to the magic constant this book magic square based on yin yang principle teaches the reader the methodology in solving all the magic square from the order 3 to the order n firstly from the yin yang pair of symmetry asymmetry we category all the magic squares into 3 categories namely the 2n 1 4n and 4n 2 the categorization becomes the backbone of how we developed the methodology in solving the magic square secondly the yin yang pairs of movable immovable and clockwise anticlockwise are used to solve magic square in few steps each category has its own methodology the methodology derived from this is of graphical type thus from this graphical type we can use the cut paste function another yin yang pair from excel spreadsheet to solve the magic square especially for the higher order magic square lastly the book teaches how to obtain the variation for solving the magic square for instance for magic square of order 9 you can obtain to more than 1 million solutions magic squares are a great way for kids to practice addition combined with logical thinking this magic square is a variation in the normal puzzle the sums around the grid are always 15 but that limits the number of magic puzzles you can make with this game the sums are not always 15 how does the magic square works you have to write in every square a unique number for a 3 x 3 grid you must use the numbers from 1 to 9 and for 4 x 4 grid the numbers 1 to 16 the sum of the numbers in the rows columns and the diagonal must be the same as the numbers are printed around the

puzzle remember you can only use every number once in the puzzle magic squares are a great way for kids to practice addition combined with logical thinking this magic square is a variation in the normal puzzle the sums around the grid are always 15 but that limits the number of magic puzzles you can make with this game the sums are not always 15 how does the magic square works you have to write in every square a unique number for a 3 x 3 grid you must use the numbers from 1 to 9 and for 4 x 4 grid the numbers 1 to 16 the sum of the numbers in the rows columns and the diagonal must be the same as the numbers are printed around the puzzle remember you can only use every number once in the puzzle these pan magic square puzzles in this book consists of 25 rectangles built as a 5x5 rectangle shape a panmagic square pandiagonal magic square diabolic square diabolical square or diabolical magic square is a magic square with the additional property that the broken diagonals i e the diagonals that wrap round at the edges of the square also add up to the magic constant magic squares are among the more popular mathematical recreations over the last 50 years many generalizations of magic ideas have been applied to graphs recently there has been a resurgence of interest in magic labelings due to a number of results that have applications to the problem of decomposing graphs into trees key features of this second edition include a new chapter on magic labeling of directed graphs applications of theorems from graph theory and interesting counting arguments new research problems and exercises covering a range of difficulties a fully updated bibliography and index this concise self contained exposition is unique in its focus on the theory of magic graphs labelings it may serve as a graduate or advanced undergraduate text for courses in mathematics or computer science and as reference for the researcher what is a magic square puzzle these magic square puzzles in this book consist of 49

rectangles built as a 7x7 rectangle shape what is a magic square puzzle there are 3 084 magic square puzzles in this book each one consist of 49 rectangles built as a 7x7 rectangle shape and you must find the correct missing numbers for your help the sum of the magic square is given the first volume has all 3 084 unsolved magic squares and the second volume has all 3 084 solutions of them have you ever purchased a book on games only to find that you have the same old run of the mill rules that you learned as a child dominoes plus is 100 exciting games 90 of them original a professional writer explains to you the complete and detailed set of rules for each game similar games are grouped into topical chapters with 25 illustrations for reference that you will remember an appendix provides a user friendly cross reference for finding a game to match ages and number of players the author begins with a history of dominoes and throughout the book introduces the topic of dominoforms which explain typical features and structures of tile games they are at once both familiar in their general styles of play and concise in their treatment breathe new life into those tired old checkers card and dice games as you combine them with dominoes in interesting new games the second half of the book describes many such games dominoes plus is a guidebook as much as a reference if you don t have someone at hand eager to play the author offers ideas on how to find a game this book comprises solution of every question of class 7th mathematics this book is prepared as per the guidelines syllabus and marking scheme issued by cbse for class vii summative assessment i and ii the salient features of this book are this book have been so designed that complete syllabus is covered this book helps student in identify their weak areas and improve them also it will help students gain confidence and will help students evaluate their reasoning analysis and understanding of the subject matter intended as a resource for teaching the national curriculum

for mathematics the numeracy hour and the scottish guidelines for mathematics 5 14 this book provides coverage of the main ideas in number for pupils from 7 to 11 years old it contains structured lesson plans 71 linked copymasters that develop number skills number investigations and games continual and end of section assessments and a planner linking the lessons to the national curriculum the national numeracy project and the scotland 5 14 guidelines magic squares are a great way for kids to practice addition combined with logical thinking this magic square is a variation in the normal puzzle the sums around the grid are always 15 but that limits the number of magic puzzles you can make with this game the sums are not always 15 how does the magic square works you have to write in every square a unique number for a 3 x 3 grid you must use the numbers from 1 to 9 and for 4 x 4 grid the numbers 1 to 16 the sum of the numbers in the rows columns and the diagonal must be the same as the numbers are printed around the puzzle remember you can only use every number once in the puzzle

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- General Solutions For Even Order Magic Squares
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- Your Magic Square Puzzles For Kids
- Your Magic Square Puzzles For Kids
- Books Magic Square Puzzles For Kids
- Kids Magic Square Numbers Books Puzzles
- Numbers Magic Square BooksFor Kids Puzzles
- Magic Square 7x7 Find The Solution
- 3084 Magic Squares 7x7
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- Before Sudoku
- Magic Square
- Magic Polygons

- The Zen Of Magic Squares Circles And Stars
- Pan Magical Squares
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