

## Cambridge Integrated Science Examination Papers

This is the latest updated edition of the University of Cambridge's official statistics and Ordinances.

This book examines important advances and offers a realistic image of the state of the art in student learning outcomes assessment in higher education—a field close to the core of nearly every higher education institution. Producing sound information on what students know and can do is critical to higher education practitioners and future social prosperity. Spanning international, national and institutional developments, the book presents methodological and empirical insights, highlights research challenges, and showcases the enormous progress made in recent years. The book will be of interest to researchers in education assessment and neighbouring fields, and stakeholders like institutional leaders, teachers and graduate employers looking for better insight on returns, governments searching for information to assist with funding and regulation, and members of the public wanting more clarity about outcomes and public investment. This book was originally published as a special issue of *Assessment & Evaluation in Higher Education*.

Endorsed by Cambridge International Examinations. Develop your students' computational thinking and programming skills with complete coverage of the latest syllabus from experienced examiners and teachers. Follows the order of the syllabus exactly, ensuring complete coverage. Introduces students to self-learning exercises, helping them learn how to use their knowledge in new scenarios. Accompanying animation files of the key concepts are available to download for free online. See the Quick Links to the left to access. This book covers the IGCSE (0478), O Level (2210) and UK GCSE entry (0473) syllabuses, which are for first examination 2015. It may also be a useful reference for students taking the new Computer Science AS level course (9608).

## Technical Innovation

Report of the Northern Ireland Schools Examinations Council

Innovations in Science and Technology Education

Cambridge IGCSE® and O Level Computer Science Programming Book for Python

Assessing Student Learning Outcomes in Higher Education

Integrated Governance

This volume provides an international perspective on educational dependency in considering both theories and actual developments throughout the world. Some less developed countries, in expanding their education systems, have emulated Western academic-style systems and have increased their dependence on Western models in various respects including examination validation. Others have deliberately avoided this path and have experimented with systems more 'relevant' to development, often in a radical way. At a theoretical level, Marxist and neo-Marxist development theorists argue that education systems dependent on the West are evidence of economic dependency and confirmation of Marxist development theories; while others argue that the evidence suggests an interdependent world and that dependency theories do not apply in education.

*Cambridge English Proficiency 2* contains four complete and authentic examination papers for Cambridge English: Proficiency, also known as Cambridge Certificate of Proficiency in English (CPE). This collection of examination papers provides the most authentic exam preparation available. These examination papers allow candidates to familiarise themselves with the content and format of the exam and to practise useful examination techniques. Audio CDs containing the exam Listening material, a Student's Book with answers, and a Student's Book with answers with downloadable Audio are available separately.

Over the course of developments in formal and informal education in Hong Kong from the end of 1941 to the beginning of the new millennium. As was true of its predecessor, each Part of this book is subdivided into three sections: Commentary, Chronicle, and Evidence. Such an organization facilitates flexible reading. Readers primarily interested in analysis, interpretation, and the identification of themes are likely to focus initially on the Commentary sections and to move, as they feel stimulated, to the relevant entries in the Chronicle and/or Items of Evidence. Readers who seek either more encyclopedic understanding or detailed answers to specific questions may well wish to focus primarily or at least initially on the Chronicle sections, and then to search for substantiation in the Evidence section or for amplification in the author's Commentary. At times, some readers may wish to browse through the Evidence sections, reaching possibly serendipitous discoveries. Academic and general readers are likely to be particularly interested in Part I of the book, which deals with education in Hong Kong during the Japanese occupation, a topic that has received only very rare and generalization-based treatment in other publications. The author offers insights into all levels of education. His conceptual scope incorporates many types of education - including the mainstream academic education, teacher education, special education, physical education, civic education, education that focuses on morals, that which focuses on culture, and the various sorts of non-formal and informal education.

## Integrated Science

Visions and Revisions

Cambridge Primary Science Stage 4 Activity Book

Cambridge University Guide to Courses

Parliamentary Papers

Science Education in the Asian Region

*Cambridge Primary Science is a 4th-grade engaging course written specifically for the Cambridge Primary Science curriculum framework. This Activity Book for Stage 4 contains exercises to support each unit in the Learner's Book, which may be completed in class or set as homework. Exercises are designed to consolidate understanding, develop application of knowledge in new situations, and develop Scientific Enquiry skills. There is also an exercise to practise the core vocabulary from each unit.*

*Abstract of this volume was 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 educational and philanthropic project founded in 1986, 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 Social Cultural Elements into Mathematics Education <https://doi.org/10.37626/GA9783959872188.001> First page: 1 Last page: 6 Abstract Our study attempted to address young Bedouin (desert tribes) students' persistent difficulties with mathematics by integrating ethnomathematics 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 embroideries. 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. 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, .....*

*https://doi.org/10.37626/GA9783959872188.002* First page: 7 Last page: 11 Abstract "Decision is the central intellectual activity in our everyday lives" and "statistics is central to these activities (Langford, 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 in 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 <https://doi.org/10.37626/GA978395872188.003> 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 28%; No 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 pursuit to pursue STEM related fields, rather than stating that "I do not love mathematics anymore." .....

*https://doi.org/10.37626/GA978395872188.004* 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

*https://doi.org/10.37626/GA9783959872188.005* First page: 24 Last page: 25 ..... Cynthia Orpessa Anhali, 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 <https://doi.org/10.37626/GA9783959872188.006> First page: 26 Last page: 31 Abstract Research in prospective teachers' modeling work for introducing 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 paper explores the 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 <https://doi.org/10.37626/GA978395872188.007> 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 footballs 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 .....

*https://doi.org/10.37626/GA978395872188.008* 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 PCR model for pre-service mathematics teachers. The study involved 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 related 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. .... Sarah Bansal Analyzing the Demands of an Assessment in a Geometry Pedagogic Content Knowledge Module <https://doi.org/10.37626/GA978395872188.008> 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 PCR model for pre-service mathematics teachers. The study involved 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 related 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 <https://doi.org/10.37626/GA978395872188.009> First page: 41 Last page: 43 .....

*https://doi.org/10.37626/GA978395872188.010* 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 engaging and honing these skills (Grossman, Hammerness, & McDonald, 2009): a correlative approach in teacher education necessitates organizing coursework and fieldwork around practices of the teaching profession while simultaneously providing teacher candidates (TCs) ample opportunities to "practice" by enacting these teaching practices. In this paper, we share our correlative instructional strategies, along with 95 research on 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 <https://doi.org/10.37626/GA978395872188.011> 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 effective 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 <https://doi.org/10.37626/GA978395872188.012> First page: 56 Last page: 62 Abstract We present an innovative educational path for high school and University studies. The topic is related 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. .... Bernadino Canon The Advantage of Learning Mathematics and Lakatos's Legacy <https://doi.org/10.37626/GA978395872188.013> First page: 63 Last page: 68 Abstract Magic squares are key tools in mathematics teaching. They foster 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 perspective, introducing the symmetry link with the idea of invariance in Montegranaro (Italy). Using the 3x3 magic square and manipulation games, a sample of 101 pupils (8 years) explored symmetry, reflection, and rotations associated with the square. The proposed activities provide tools and experience for geometric cognitive process training from magic squares to main geometric shapes. The findings confirm the symmetry linked to the search for invariance is appropriate and accessible for primary school pupils through manipulation games. .... 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Gail Burrill Data Science and Mathematical Modeling: Connecting Mathematics to the World in which Students Live <https://doi.org/10.37626/GA978395872188.016> 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 summary illustrates 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..." (Ebrahimi, 2010) .....

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This summary illustrates 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..." (Ebrahimi, 2010) .....

*https://doi.org/10.37626/GA978395872188.017* 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 session 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 <https://doi.org/10.37626/GA978395872188.018> 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 address these problems, and view mathematics as a force for societal good. .... Bernardo Canon The Advantage of Learning Mathematics and Lakatos's Legacy <https://doi.org/10.37626/GA978395872188.019> First page: 101 Last page: 106 Abstract Magic squares are key tools in mathematics teaching. They foster 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 perspective, introducing the symmetry link with the idea of invariance in Montegranaro (Italy). Using the 3x3 magic square and manipulation games, a sample of 101 pupils (8 years) explored symmetry, reflection, and rotations associated with the square. The proposed activities provide tools and experience for geometric cognitive process training from magic squares to main geometric shapes. The findings confirm the symmetry linked to the search for invariance is appropriate and accessible for primary school pupils through manipulation games. .... Angela Broaddus & Mathew Broaddus Assessing Mathematical Reasoning: Test Less - Explain More <https://doi.org/10.37626/GA978395872188.014> 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 initiation 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 Budinova & Jitka Panthová Children with Reduced Cognitive Effectivity, their Problems and Optimal Way of Education <https://doi.org/10.37626/GA978395872188.015> First page: 75 Last page: 80 Abstract The contribution deals with children with reduced cognitive effectivity, their specific, and frequent difficulties in learning mathematics in the first years of education. Two examples of children with reduced cognitive effectivity will illustrate the specific ways in which reduced cognitive effectivity 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 for these children. .... Gail Burrill Data Science and Mathematical Modeling: Connecting Mathematics to the World in which Students Live <https://doi.org/10.37626/GA978395872188.016> 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

<https://doi.org/10.37626/GA9783959872188.0066> First page: 354 Last page: 354 ===== Svenja Müller & Anna Faith-Sirek Risk Literacy in the Context of Stochastics and Mathematical Education <https://doi.org/10.37626/GA9783959872188.0067> 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 stochastic. ===== M. Estela Navarro Robles Elementary Teachers Reaching a Quasi-complete Knowledge of Rational Numbers through an Online Course <https://doi.org/10.37626/GA9783959872188.0068> 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 adaptive 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 quasi-complete conceptualization, whose meaning for us 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 Video Stimulated Recall <https://doi.org/10.37626/GA9783959872188.0069> First page: 367 Last page: 372 Abstract Continuous professional development should be navigated in a teacher's own context, addressing their particular needs where timeless 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 noticing, 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 Ngobho Evoking School Mathematical Knowledge among Preservice Secondary Mathematics Teachers through Error Analysis <https://doi.org/10.37626/GA9783959872188.0070> First page: 372 Abstract This article explores how attention to Specialised Content Knowledge (SCK) could evolve 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 is needed by PSMTs and how it should be developed had been meagre. 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 research 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' professionalism. 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 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 <https://doi.org/10.37626/GA9783959872188.0071> 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, group of month, the university marketing department, visits to collegiate mathematics classrooms at the level of calculus and above. This project was supported by The National Science Foundation (NSF) as a Novice project and will support students financially with full cost of attendance for the final two years of the four-year program. ===== Elizabeth Oldham & Abhinav Bhatt Undergraduate Mathematics Students' Reflections on School Mathematics Curricula after a Major Curriculum Change in Ireland <https://doi.org/10.37626/GA9783959872188.0072> 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 Onoma Mismatch between Spoken Language and Visual Representation of Mathematical Concepts <https://doi.org/10.37626/GA9783959872188.0073> First page: 384 Last page: 388 Abstract This paper examines secondary students' mismatch in meaning between spoken language and visual representation of mathematical content of a right-angled 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 Panige & Alina Degteva Project-based Learning in Statistics <https://doi.org/10.37626/GA9783959872188.0074> First 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 educational 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 <https://doi.org/10.37626/GA9783959872188.0075> 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 <https://doi.org/10.37626/GA9783959872188.0076> First page: 401 Last page: 406 Abstract In this paper we deal with the mathematical-object 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 effect. ===== Maria Piccione & Francesca Ricci Activities and Tools for Early Developing Symbol-sense <https://doi.org/10.37626/GA9783959872188.0077> 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 semantic fields (gestural, iconic, natural, ...) to achieve the mathematical field. ===== Shelley B. Poole The "Yes, and..." Approach to Teaching Mathematical Modelling <https://doi.org/10.37626/GA9783959872188.0078> 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. Anderson Analysing PSTs Ethical Reasoning in a Data Driven World <https://doi.org/10.37626/GA9783959872188.0079> First page: 418 Last page: 424 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 structure 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 mathematical 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 Torii & Julie A. Bianchini A Mathematics Specialist Supporting District Shifts in Instruction for Mathematics Education in the United States <https://doi.org/10.37626/GA9783959872188.0080> First page: 424 Last page: 428 Abstract Mathematics specialists fill a gap in providing individualized professional learning for classroom teachers, including facilitating 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 two full 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 <https://doi.org/10.37626/GA9783959872188.0081> 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 <https://doi.org/10.37626/GA9783959872188.0082> First page: 434 Last page: 438 Abstract The University of North Carolina State 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 Røj-Lindberg Trends in Mathematics Education in Finland <https://doi.org/10.37626/GA9783959872188.0083> First page: 443 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 <https://doi.org/10.37626/GA9783959872188.0084> 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. Ruchton, Melina Alexander & Shirley Dawson Mathematics to Teacher Education Persistence <https://doi.org/10.37626/GA9783959872188.0085> 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. ===== Robyn Rutenberg-Rosen In-the-Moment Narratives: Interventions with Learners Experiencing Mathematics Difficulties <https://doi.org/10.37626/GA9783959872188.0086> First page: 457 Last page: 462 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 vulnerable students. This study explores the use of in-the-moment narratives between the instructor and learner to address mathematics difficulties. 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. ===== Tanishq Kumar Sah Extension of Theories <https://doi.org/10.37626/GA9783959872188.0087> 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  $\pi$  (periodicity of the tangent function). For tangent function we know that  $\tan(\pi - x) = -x$ , but the expression  $\tan(\pi n - x)$  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 our point of view. Geometrical shapes and their relations are very important for many things 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  $\pi$ . 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 <https://doi.org/10.37626/GA9783959872188.0088> First page: 466 Last page: 471 Abstract Song-based mathematics 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 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 <https://doi.org/10.37626/GA9783959872188.0089> 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 this 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 Saralaz-Aras & Betül Esen Designing Lessons for the 5th Graders through a Design Study on Teaching Polygons <https://doi.org/10.37626/GA9783959872188.0090> 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 3 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 design-based research. It is hoped that the lesson plans set an example for teachers and teacher candidates. ===== Stephanie Sheehar-Braine & Irina Lyubinskaya A Framework for Online Problem-Based Learning for Mathematics Educators <https://doi.org/10.37626/GA9783959872188.0091> 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 vulnerable students. This study explores the use of in-the-moment narratives between the instructor and learner to address mathematics difficulties. 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. ===== M. Vali Sidiqat Keystone Model of Teaching and Learning in Mathematics <https://doi.org/10.37626/GA9783959872188.0092> 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, Nural Akma Md Nasir & Teoh Shan Hoon The Death of Development in Mathematical Thinking Among High School Leavers <https://doi.org/10.37626/GA9783959872188.0093> 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 to solving problems of different areas of learning. Thus, to assess this context, a mixed-method 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 death 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: Rudnickian thinking, problem solving, non-routine, heuristics. ===== Praneetha Singh Mathucation: Creativity and Innovation in the Mathematics Classroom <https://doi.org/10.37626/GA9783959872188.0094> 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 & Rudnik (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 <https://doi.org/10.37626/GA9783959872188.0095> 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 <https://doi.org/10.37626/GA9783959872188.0096> First page: 512 Last page: 517 Abstract The Invented (2017) Polyhedron, is a Non-Regular Icosahedron, it has 12 Isosceles triangles & 8 Equilateral ones. Its Skeleton Structure consists of 3 Parallelogram Planes Orthogonal to each other, with sides' ratios based on the Square Root of the Golden Number [ratios of 4/7 specially for  $\pi = 4T = 3.14460551...$ , where T is the Square Root of the Golden Number ( $\sqrt{5}$ ) 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). ===== Ching-Yu Tseng, Paul Foster, Jake Klinker, Elizabeth Adams, Corey Clark, Eric C. Larson & Leanne Ketterlin-Geller Evaluating the Students' Computational Thinking during Gamaplay <https://doi.org/10.37626/GA9783959872188.0102> 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 game called Minecrafter. The learning environment included a Minecrafter mod, a custom companion application, and a learning management system integration. The authors 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 some 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 Vaccaruto GROWE in Math <https://doi.org/10.37626/GA9783959872188.0103> 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' 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 Leano 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-achieving students: the authentic texts used and related tasks, and some implementation results. ===== Shin Watanabe & Takako Aoki In School and Out School <https://doi.org/10.37626/GA9783959872188.0104> First page: 559 Last page: 559 Abstract Currently, learning in developed countries is centered 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, Arif Ström, Bismark Akoto, Dexter Lim Representational Competence with Linear Functions: A Glimpse into the Community College Algebra Classroom <https://doi.org/10.37626/GA9783959872188.0105> 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 <https://doi.org/10.37626/GA9783959872188.0106> 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 its trainers 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 possible 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 <https://doi.org/10.37626/GA9783959872188.0107> First page: 569 Last page: 573 Abstract Deep, flexible number understandings are foundational for mathematics sense. 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 with numbers, and mathematical properties). ===== Ryan G. Zonnefeld & Courtney L. Zonnefeld Mathematics Education in the Digital Age <https://doi.org/10.37626/GA9783959872188.0109> 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 (2011) 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 Education Statistics confirms that one 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 <https://doi.org/10.37626/GA9783959872188.0109> 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. This book presents an international perspective of the influence of educational context on science education. The focus is on the interactions between curriculum development and implementation, particularly in non-Western and non-English-speaking contexts (i.e., outside the UK, USA, Australia, NZ, etc.). ===== Statistics of the University of Cambridge and Passages from Acts of Parliament Related to the University Graphic Showbiz Education in Hong Kong, 1941 to 2001 The Athenaeum Development, Dependency and Science Education Authentic Examination Papers from Cambridge English Language Assessment Integrated History and Philosophy of Science (IHPS) is commonly understood as the study of science from a combined historical and philosophical perspective. Yet, since its gradual formation as a research field, the question of how to suitably integrate both perspectives remains open. This volume presents cutting edge research from junior IHPS scholars, and in doing so provides a snapshot of current developments within the field, explores the connection between IHPS and other academic disciplines, and demonstrates some of the topics that are attracting the attention of scholars who will help define the future of IHPS. Integrated Science: Science without Borders™ is the first volume of the INTEGRATED SCIENCE Book series, aiming to publish the results of the most updated ideas and reviews in transdisciplinary fields and to highlight the integration of discrete disciplines, including formal sciences, physical-chemical sciences and engineering, biological sciences, medical sciences, and social sciences. This volume primarily focuses on the research involving the integration of two or more academic fields offering an innovative, borderless view, which is one of the main focuses of the Universal Scientific Education and Research Network (USERN). The whole world is suffering from complex problems; these are borderless problems; thus, a borderless solution could merely solve such complex issues. Transdisciplinary science is a domain, that researchers work jointly, using a shared conceptual framework, drawing together disciplinary-specific theories, concepts, and approaches to address common problems. Lack of confidence, lack of expertise, complexities of healthcare, the confusing nature of healthcare environments, and lack of organization and standardization are the obstacles of successful scientific communication. Consequently, this book provides an overview of the essential elements of transdisciplinary studies and integrated science. The unique aspect of this book -privileging it from other books- is covering all aspects of science as harmonies of a single symphony. This edited volume presents a collection of empirical studies examining the teaching and learning processes in science classrooms in Content and Language Integrated Learning (CLIL) contexts. It is a timely contribution to the rapidly growing body of CLIL research in response to scholars' consistent calls for more classroom-based research on the issues in integration of content and language teaching in lessons. With the dual goal of content and language learning, students in CLIL programmes are also facing double challenges – mastery of abstract, cognitively demanding content knowledge and unfamiliar academic language. Focusing on the notion of " scaffolding ", this edited volume demonstrates how science teachers can provide appropriate and timely scaffolding for their students to overcome the challenges in CLIL science classrooms. With studies from different educational settings (Hong Kong, Mainland China, Singapore and Australia) and epistemological paradigms, and adopting a variety of research designs, this volume will provide key insights into CLIL pedagogy and teacher education. Originally published as special issue of Journal of Immersion and Content-Based Language Education 7:2 (2019). ===== Statistics and Ordinances of the University of Cambridge 2004 Cambridge University Press ===== Education in the Third World ===== 60th Anniversary ===== The ICASE Journal ===== Dependence and Interdependence in Education ===== Because marine governance in most countries is sectoral, maritime policies are frequently fragmented, reactive, and even contradictory, meaning that marine resources are underutilized and poorly protected. To avoid these problems, the concept of integrated national maritime policy (INMP) has been developed. This book examines this concept, analysing its current application in four countries – Australia, Canada, UK and USA – whilst discussing at length how it might be applied to Saudi Arabia. Based on extensive fieldwork carried out in Saudi Arabia – including interviews with officials in government departments with maritime responsibilities, and a survey administered to 230 stakeholders – the book offers a unique insight into INMP in the Kingdom. The book provides a practical template for developing the political will and civil constituency in Saudi Arabia necessary for the introduction of INMP. In setting out in detail its benefits, this book could help build the momentum in Saudi Arabia required to implement the concept as well as attract other countries to do the same. A significant contribution to the

*growing literature on ocean governance, this book will be of great importance to policy makers and scholars of Middle Eastern studies, marine governance and comparative politics.*

*Teaching, Learning and Scaffolding in CLLL Science Classrooms*

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