TEACHING AND LEARNING MATHEMATICAL MODELLING pdf

1: Teaching and Learning Mathematical Modelling | PDF Free Download

This book contains suggestions for and reflections on the teaching, learning and assessing of mathematical modelling and applications in a rapidly changing world, including teaching and learning environments.

Introduction The purpose of this paper is to examine the possibility of introducing the teaching of mathematical modelling to the secondary school curriculum in Singapore. As well, the benefits of teaching and learning mathematical modelling are discussed. Examples to illustrate the process of mathematical modelling using only basic mathematical ideas and concepts are presented. These serve to illustrate that school mathematics can be used to provide experiences of the process of mathematical modelling in the classroom. Some implications on the teaching and learning of mathematics using such an approach are examined and discussed. One of the primary aims of mathematics education for secondary schools in Singapore is to enable pupils to acquire the necessary mathematical knowledge and skills and to develop thinking processes so as to apply them in mathematical situations in real life. In principle, with mathematical problem solving as a theme, the curriculum is expected to focus on applying mathematics in practical situations and real life problems. In the process of delivering the curriculum, it is hoped that mathematics learners will not only appreciate the beauty of the subject but also the usefulness and power of mathematics. In practice, however, the emphasis has been on solving routine mathematical problems in a context-free environment. The problem is usually complete by itself, and is presented in a very clean and tidy state. Such practice makes it difficult to convince the learner that real life applications of mathematics do indeed exist. In addition, mathematics has often been thought of by pupils as consisting of a set of distinct topics that are compartmentalised and self-sufficient. In real life, however, problems tend to transcend a number of disciplines and are often not so well defined. Often, we need to apply ideas and concepts in one area to solve problems arising in another. Mathematical modelling offers excellent opportunities to connect and use ideas from different areas. The rapid development of computers and their availability in the classroom have had a tremendous impact on the expectations of the computational skills of all students. Skills thought to be essential in the mathematics curriculum may not be so in future Arora and Rogerson, However, applications of mathematics in problem solving and mathematical modelling should remain an integral part of the curriculum, because these will always be useful. What is Mathematical Modelling? Mathematical modelling is a process of representing real world problems in mathematical terms in an attempt to find solutions to the problems. A mathematical model can be considered as a simplification or abstraction of a complex real world problem or situation into a mathematical form, thereby converting the real world problem into a mathematical problem. The mathematical problem can then be solved using whatever known techniques to obtain a mathematical solution. This solution is then interpreted and translated into real terms. Figure 1 shows a simplified view of the process of mathematical modelling. A simple view of the mathematical modelling process The above is, of course, a grossly simplified definition for the usually complex process of modelling. However, for the purpose of the present discussion, it is sufficient to note that in mathematical modelling, the starting point is a real world problem or situation. As we shall see, in mathematical modelling, the emphasis is in solving a problem rather than finding an answer that must exist. Sometimes, we may not even be able to solve the problem entirely, although we hope to move one step closer to obtaining a solution. Hence, when we approach the teaching of mathematics through mathematical modelling, we are really teaching mathematical problem solving. We present mathematics in action, instead of as a confusing set of formulae scribbled on the chalkboard. We place mathematics in some context and focus on why mathematics exists in the first place. Moreover, many challenging and exciting skills are used in developing models and these have often been ignored in traditional school mathematics Abrams, Some of these will become apparent in the next section when we examine specific examples. Examples In this section, examples of how the process of mathematical modeling may be introduced in the classroom using basic mathematical ideas and concepts are presented. Some of these examples are adapted from sources such as Swetz and Hartzler , Wood , and Blane and Evans This context-free way of teaching is efficient and neat. However, it may be more interesting to see how such a graph and function can actually arise

from a real practical situation. Consider the following situation where water flows from a tap into a measuring cylinder at a constant rate as depicted in Figure 2. Suppose we wish to construct a model to show how the water level changes with time so that we can predict how long it would take to fill the whole cylinder. The water level at various points in time can be read off the measuring cylinder. The data is recorded in the form of a graph as shown. Representing rise in water level using a linear function From the data, we can now try and guess the relationship between the water level,y, and the time after the tap is turned on, t, assuming that the initial water level is c. The linear function is given some context and the graph actually represents something real and physical. Furthermore, the process of modelling would hopefully enable the learner to appreciate other related concepts. For instance, we get a steeper gradient of the graph when the rate of water flowing from the tap is increased. The car park problem A typical school compound would normally have some car park space. The parking lots are usually already painted, lines drawn and so on. Suppose we wish to check to see if the existing plan has made maximum use of the car park space. If not, we wish to re-design the space to increase the number of lots. Such a problem would involve questions like the following: How many cars can be parked along one curb using parallel parking? How much space should there be for traffic within the car park? We can first assume that a typical width, w, for a lot is 2. Suppose we fix the lot width w and wish to see how the curb space varies with the angle of the lot. Using a simple spreadsheet, we can generate a table of values see Table 1 and its graph see Figure 4 as follows: Values of q and x Figure 4: Graph of curb space against angle of lot q.

TEACHING AND LEARNING MATHEMATICAL MODELLING pdf

2: Learning Theories and Models summaries - Educational Psychology

The approaches to teaching mathematical modelling have been influenced by the development and introduction of technologies such as graphing calculators and computer software (Ferrucci and.

Prepare the lesson well , particularly if you are going to conduct a demonstration that is new to you. If you are about to model something new for the first time, you might write out a script and rehearse what you are going to say see resources in the As you grow in confidence, it will no longer be necessary to write out a script but you will still plan exactly what you want the pupils to learn. Model your thinking to explain links between an idea they have seen before and the one you are about to introduce, for example, in chemistry you may have used ping pong balls to represent atoms but in Year 8 different sized balls are used so that pupils can build molecules. Think out loud the connections and the reasons for developing or changing this model. See also the section on demonstrations in maintaining a view of the class while writing notes or instructions for them by using an OHP, a laptop or an interactive whiteboard rather than turning your back to the class. By your behaviour when you are writing you are modelling the technique. Maintain the pace of the lesson by using modelling for short periods only, especially if pupils are not used to this way of working. Repeat the modelling of a process whenever necessary. Some skills are only acquired through repeated practice. Modelling processes with pupils involves establishing clear aims; exploring thinking â€" yours and the pupils; demonstrating the process; working together through the example; providing prompts or scaffolds as appropriate; providing an opportunity for pupils to work themselves alone or in pairs ; drawing out the key learning. Teachers can model a range of processes, for example, how to use a particular piece of equipment appropriately and accurately; how to record data; how to evaluate an investigation; how to plan a more complex investigation; how to draw a particular graph or representation; how to obtain specific information from a text or from the Internet; how to answer a test question ; how to improve writing ; how to improve the quality of talk Adapted from Modelling Introduction , section Body. It could be considered the first step towards enabling children to design and create their own games tool using sprites and user-input controls. Computer programming helps to develop investigation ta skills as it requires the use of a previously unknown language ta to execute commands, which also develops the skills of mathematical thinking ta. Computer programming also involves the use of modelling ta and planning ta techniques. Because Scratch is an open source programming language, this also creates opportunities for homework ta , as the children are able to download the software for themselves at home. Persuasive argument and evidence-based conclusions about the best car Got a new motor? The teacher will model ta and encourage the use of the language ta that children require to discuss or present their data. The teacher can explain their rationale using the lesson below. Modelling Scientific Writing How do we help pupils to express themselves adequately when they write? This resource discusses methods for modelling ta scientific writing, and the structure and kinds of language ta used in such writing. It provides exemplars and suggests activities to assist teachers to apply these methods to their own practice. Each workshop is part tutorial and help in GeoGebra, part development, presentation and feedback on their emerging work. The three half-day sessions become gradually less structured as students become more confident taking the initiative in developing their own work: The activity engages pupils in group talk ta , mathematical thinking ta and vocabulary ta.

TEACHING AND LEARNING MATHEMATICAL MODELLING pdf

3: Teaching approaches: Modelling - OER in Education

Applications and modelling and their learning and teaching in school and university have become a prominent topic in the last decades in view of the world-wide importance of the usage of mathematics in science, technology and everyday life.

Submitted by plusadmin on September 1, September This is the second installment of a new feature in Plus: Every issue contains a package bringing together all Plus articles about a particular subject from the UK National Curriculum. What do you think? So if you are teacher, a student or any other interested Plus reader with thoughts on this new series, then please get in touch. Plus articles go far beyond the explicit maths taught at school, while still being accessible to someone doing A level maths. They put classroom maths in context by explaining the bigger picture â€" they explore applications in the real world, find maths in unusual places, and delve into mathematical history and philosophy. We therefore hope that our teacher packages provide an ideal resource for students working on projects and teachers wanting to offer their students a deeper insight in the world of maths. Mathematical modelling Mathematics is often called "the language of the universe". With mathematics, we can describe and make predictions about the behaviour of things around us. The results are often better than ever expected â€" in fact, one mathematician even wrote an essay about what he called the "unreasonable effectiveness" of mathematics in solving physical problems! The Plus articles listed below all deal with mathematical modelling. We have divided them into three categories. Explicit maths articles contain explicit examples or proofs that can be worked directly into classroom activities and discussions. Articles in the middle ground category also contain explicit maths, but require the reader to fill in the details â€" possible material for student projects. The bigger picture category contains articles that focus on concepts and give an overview of an area, making for eye-opening background reading. In addition to the Plus articles, the try it yourself section provides links to related problems on our sister site NRICH. Explicit maths â€" get your hands dirty with some real maths. The middle ground â€" enter the wonderful world of modelling and get a glimpse of the equations too. The bigger picture â€" go beyond what you can do in the classroom. From our sister website NRICH , these problems are graded by school level and challenge difficulty, so that you can find investigations suitable for yourself or your students. Explicit maths Mathematical modelling in medicine and nature Classroom activity: Build your own disease â€" Explore how to model the spread of an infectious disease. Maths and climate change: Mathematical modelling is key to predicting how much longer the ice will be around and assessing the impact of an ice free Arctic on the rest of the planet. Sex, evolution and parasitic wasps â€" Some things are so familiar to us that they are simply expected, and we may forget to wonder why they should be that way in the first place. Sex ratios are a good example of this: A mathematical model provides an answer. Pools of blood â€" A biologist has developed a blood test for detecting a certain minor abnormality in infants. Obviously if you have blood samples from children, you could find out which children are affected by running separate tests. But mathematicians are never satisfied by the obvious answer. Keith Ball uses information theory to explain how to cut down the number of tests significantly, by pooling samples of blood. Lewis Dartnell presents a hands-on guide for creating your own simulations â€" no previous experience necessary. And why do we prefer to break into a run rather than walk above a certain speed? Using mathematical modelling, R. McNeill Alexander finds some answers. Guilt counts â€" Guilt, so some people have suggested, is what makes us nice. A team of scientists have recently month produced some new results in this area, using a model from psychological game theory. Mathematical modelling in economics, politics and human interaction Game theory and the Cuban missile crisis â€" Steven J. Brams uses the Cuban missile crisis to illustrate the Theory of Moves, which is not just an abstract mathematical model but one that mirrors the real-life choices, and underlying thinking, of flesh-and-blood decision makers. Hold out for The Only One? Simply try and avoid the really bad ones? How long should you wait before cutting your losses and settling down with the next best who comes along? John Billingham models the problem and saves the national grid in the process. Slug wars , Graphical Methods II: The return of the slime and Graphical methods III: A new mathematical model has some good news and some bad news for you. Which would you like to hear first?

TEACHING AND LEARNING MATHEMATICAL MODELLING pdf

What can birds tell us about flying through ash clouds? Baby robots feel the love â€” Researchers have unveiled the first prototypes of robots that can develop emotions and express them too. But how do you get emotions into machines that only understand the language of maths? Modelling cell suicide â€” This article sheds light on suicidal cells and a mathematical model that could help fight cancer. Maths and Hallucinations â€” Think drug-induced hallucinations, and the whirly, spirally, tunnel-vision-like patterns of psychedelic imagery immediately spring to mind. So what can these patterns tell us about the structure of our brains? Eat, drink and be merry: Shaping our bones â€” We know that applying a force to a bone during its development can influence its growth and shape. But can we use our understanding of how developing bone reacts to mechanical forces to help people suffering from diseases that lead to bone deformities? The mathematics of diseases â€” Over the past one hundred years, mathematics has been used to understand and predict the spread of diseases, relating important public-health questions to basic infection parameters. Matthew Keeling describes some of the mathematical developments that have improved our understanding and predictive ability. How the leopard got its spots â€” How does the uniform ball of cells that make up an embryo differentiate to create the dramatic patterns of a zebra or leopard? How come there are spotty animals with stripy tails, but no stripy animals with spotty tails? Lewis Dartnell solves these, and other, puzzles of animal patterning. Mathematical modelling in games and sport The Plus sports page: The curse of the duck â€” Why do the best cricketers in the world keep scoring zero? The Plus sports page: Power trip â€” This article looks at the tenure length of football managers and fits a model to the data. Games people play â€” Combinatorial Game Theory is a powerful tool for analysing mathematical games. Lewis Dartnell explains how the technique can be used to analyse games such as Twentyone and Nim, and even some chess endgames. The bigger picture Model behaviour â€” A quick introduction to modelling, this article shows how mathematicians model complex systems by describing the most crucial elements in the simplest possible way. Mathematical modelling in medicine and nature Met Office in for another roasting? Creating a virtual cancer â€” A mathematical cancer model may lead to personalised treatment. Protecting the nation â€” Vaccination is an emotive business. To make sure it works, we need to model how diseases spread. The speed of climate change â€” Scientists model how fast temperature changes sweep the Earth. Feeling tense about healing wounds? Mathematical modelling can help you feel better. And now, the weather Modelling catastrophes â€” Hardly six months go by without a natural disaster striking some part of the globe. Chaos on the brain â€” Saying that someone is a chaotic thinker might seem like an insult â€” but, according to Lewis Dartnell, it could be that the mathematical phenomenon of chaos is a crucial part of what makes our brains work. When will they blow? Ordinary geometry is useless when it comes to dealing with such a space, but algebra makes it possible to come up with a model of spacetime that might do the trick. And it can all be tested by a satellite. Shahn Majid met up with Plus to explain. Mathematical modelling in games, sport and art Making gold for â€” Recently leading researchers in sports technology met at the Royal Academy of Engineering in London to demonstrate just how far their field has come over recent years. Supersonic bloodhound â€” In Andy Green was the first to break the sound barrier in his car Thrust SSC, which reached speeds of over mph. Now he and his team want to push things even further with a car called Bloodhound, designed to reach the dizzy heights of 1,mph, about 1. This article explains how modelling is used to build this car. Should you go for it? Rubik success in twenty-six steps â€” A simple toy, but a fiendishly complicated mathematical model is needed to prove that any scrambled cube can be solved in a maximum of twenty-six steps. In computer games, a physics engine ensures the virtual world behaves realistically. Mathematician and computer programmer Nick Gray tells us about playing God in a virtual world. Find out how to use computers to solve a fiendishly difficult jigsaw puzzle on our sister site NRICH. Mathematical modelling in technology, economics, politics and human interaction. Is maths to blame? Paying the price â€” Can a scientific approach to risk in finance avoid the next financial crisis? Plus finds out about her career path. Call routing in telephone networks â€” Find out how modern telephone networks use mathematics to make it possible for a person to dial a friend in another country just as easily as if they were in the same street, or to read web pages that are on a computer in another continent. Model Trains â€” As customers will tell you, overcrowding is a problem on trains. Fortunately, mathematical modelling techniques can help to analyse the changing demands on services through the day.

TEACHING AND LEARNING MATHEMATICAL MODELLING pdf

But now, with more of us zipping around the globe every year and the advent of no frills airlines, keeping an airline competitive has become a complicated business.

4: Teaching Mathematics Modelling

Teaching mathematical modelling national institute of, teaching mathematical modelling in singapore schools ang keng cheng national institute of education introduction the purpose of this paper is to examine the possibility of introducing the.

5: Teacher package: Mathematical Modelling | www.enganchecubano.com

Modelling is now one of the six general mathematical competencies defined in the educational standards for mathematics introduced in Germany in , and there have been several initiatives to implement modelling in schools, as well as a whole range of empirical research projects focusing on teachers or students in modelling processes.

TEACHING AND LEARNING MATHEMATICAL MODELLING pdf

Himu somogro 2 Fair rhetoric James Gilbert When police unionise Tests of a habitat suitability model for black-capped chickadees Teamwork and leadership Moisturizer Is My Rel George Cooper and others. The Pocket Guide to English Language (Literacy in Context) Maersk annual report 2016 The Black Alchemists (Phoenix Force, #12 (An Executioner Series) Systematic theory of argumentation Biodiversity Of Fungi The National Jobbank 2008 Reported sightings The vision thing : goals for your Web site Contracts in writing and third party Cmdt 2018 The Secret of Goblin Glen Redwoods, hemlocks other cone-bearing plants Executive Refreshers The book of democracy To Mom, I Love You Because . . . The devils necklace Chemistry of common substances The mystery of the present moment What Men Should Know about Christian Women Mothers Talk About Learning Disabilities Trade in health services and the GATS : introduction and summary Richard Smith, Chantal Blouin, Nick Drag FCC math problem solution workbook Contemporary business 16th edition Fake id book Ireland in pre-Celtic times Glycerol: properties and production Teach Yourself Finnish Complete Course (Book Only (Teach Yourself) The writers craft workbook Endgames: The Irreconcilable Nature of Modernity Names I Cant Remember Seed-Production Mechanisms Moving with the Ball Just the Tips, Man for Adobe Photoshop 6