MATHTED INTERNATIONAL CONFERENCE IN MATHEMATICS EDUCATION 2013

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How to Teach and What to Teach: Some recent innovative projects in mathematics education world wide.

Dr Alan Rogerson

Mathematics Education for the Future Project, Poland – alan@cdnalma.poznan.pl

Personal areas of interest in Innovation

- Assessment
- Teaching of statistics and probability
- Maths and other subjects
- Teaching methods
- Curriculum development
- Teacher education
- e-learning

Our students face a future of growing global crisis

-political

-social

-financial

-environmental

How can we **as teachers** help them confront these future challenges?

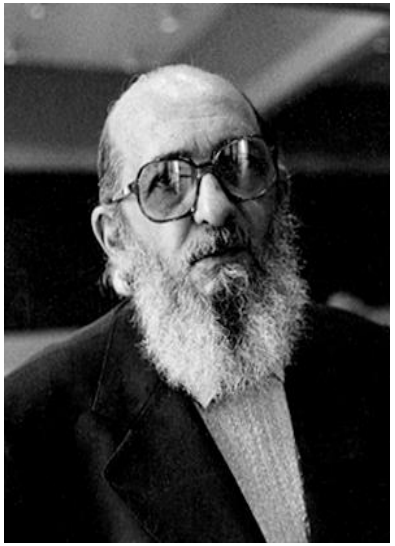
Can we, as **Paulo Freire** suggests, **empower** them to be subjects in control of their own destiny?

What are the **fundamental roles** of education and technology within **human society** that may help us do this?

Mathematics Education……. for the Future **A new paradigm shift in education**

Paulo Freire: a life-changing thinker who understood the importance of **the creative human spirit** in education.

His ***The Pedagogy of the Oppressed***, is a work full of courage, wisdom and humanism of a practical kind, which seeks to empower students, not merely to educate them.



A new (humanistic) paradigm shift for science and science education

Thomas Kuhn transformed the image of science from a dogmatic, fact-collecting and theory-creating exercise to a fallible but human search for better and different ***conceptual models*** of physical phenomena

Kuhn's concepts of ***scientific revolutions***, ***paradigm shift*** and ***normal science*** have illuminated Science as a humanistic, creative struggle, impossible to systematise in the opinion of **Feyerabend**

A new paradigm shift for maths education

Godel revealed axiomatic deductive Mathematics to be incomplete, and **Lakatos** showed the history of mathematics to be fallible, and geared to human creativity, harking back to the heuristic ideas and examples of **George Polya**.

Lakatos wrote: "I respect ***conscious guessing*** because it comes from the best human qualities - ***courage and modesty***… Certainty is not a sign of success, but of lack of imagination… The value of a logical proof is not that it compels belief, but that it suggests doubts

Change IS possible!

Dreams CAN come true!

What we can imagine CAN be made reality!

If we see today around the world

the **BEST materials**,

the **BEST ideas,**

the **BEST teaching methods,**

the **BEST software**

…….then why cannot these be used tomorrow in our schools?

Paradigm Shifts in Science and Mathematics

*The seminal ideas of **Kuhn, Lakatos and Polya** have changed the way we see the history of mathematics, science and technology, and this means **a new paradigm shift** embodied world-wide in many innovative projects in teaching and learning which show how **new classroom materials and methods** can be used not only to educate but to empower our students.*

Implications of this paradigm shift for student learning and teacher education

Problem-posing leads to Problem-solving, Modelling, and **Real Life Themes** which use

- **Relevance**
- **Motivation**
- **Group learning**
- **Self-learning**
- **Self-assessment**

These achieve **holistic integration** with other school subjects, the everyday life of students and the real world around them.

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We have seen a **paradigm shift in education** from a **subject-centred**, to **child-centred**, to **society-centred** approach.

References

Freire, P., 1974, Pedagogy of the Oppressed, New York, Continuum.

Kuhn, T.S., 1962, The Structure of Scientific Revolutions, Chicago: University of Chicago Press.

Lakatos, I., 1976, Proofs and Refutations, Cambridge, CUP.

Innovative Projects on the road from problem-solving to modelling to real life themes

- **1961-1980** The School Mathematics Project - SMP (UK) began the search for realistic themes.
- **1977 -** MUED (Germany) produced extensive problem solving and thematic materials – leading to MatheLive a thematic text book for normal schools, teachers and students.
- **1980 –** The Mathematics in Society project - MISP (UK, Australia, Italy, Spain, Poland etc)
- **1986 – 2011** The Mathematics Education into the 21st Century Project (International)

DQMEI (2004-7) and DQMEII (2007-2010)

Homepage: www.dqme2.eu

There are more than 1300 worksheets, projects and real-life themes in 10 languages on the homepage.

Contact: alan@cdnalma.poznan.pl

The budget was 631,504€ for DQMEI, and 913,769€ for the continuation project DQME II. Total budget for both projects was more than a million and a half Euro.

35 Partners

Universities

Teacher Education Institutions

Schools

Thematic Mathematics in Practice

We created many thematic units in booklet form which effectively teach mathematics implicitly: **Survival, Travel, Housing, Machines, Art, Architecture, Agriculture** etc – in fact the whole range of human activities, including, for example, **history** (The Story of Xenophon, The Life of Captain Cook, The Merchants of Venice) and **creative fiction** (Sherlock Holmes, Business Trip to Hong Kong, A Tale of Two Cities).

THE PRICES TO AUSTRALIAN DOLLARS

LET ME SEE... THIS TELLS ME HOW MUCH OF THE FOREIGN MONEY EQUALS ONE AUSTRALIAN DOLLAR

COMING ALONG?

I'VE GOT PRICES FOR FARES AND HOTELS. WHAT ELSE IS THERE?

BELOW W
COST OF L
KONG FO
HONG KO

(25) CONVERT
AUSTRALIA

(26) DO THE SAME FOR THE H
AIRPORT DEPARTURE TA

(27) WRITE DOWN THE AUSTRALIAN
DEPARTURE TAX (NOTE THIS I
AUSTRALIAN DOLLARS).

INDIA
EES = $1 AUSTRALIAN

MANY HONG KONG
S MAKE ONE
ALIAN DOLLAR?
HE TABLE →)

COUNTRY/CURRENCY	OFFICIAL RATE	YOU BUY AT	YOU SELL AT
Honduras (Lempira)	2.00	3.00	2.50
Hong Kong (Dollar)	6.73	6.73	6.72
Hungary (Forint)	39.00	42.00	38.00
Iceland (Krona)	17.00	18.00	15.00
India (Rupee)	9.70	11.80	10.80
Indonesia (Rupiah)	790.00	740.00	710.00
Iran (Rial)	85.00	—	—
Iraq (Dinar)	0.29	0.67	0.57
Ireland (Pound)	0.75	1.10	0.90
Israel (Shekel)	35.00	37.00	33.00
Italy (Lira)	1,400.00	1,500.00	1,400.00
Jamaica (Dollar)	1.80	3.30	2.80
Japan (Yen)	239.00	240.00	239.00
Jordan (Dinar)	0.35	0.37	0.34
Kenya (Shilling)	12.00	17.00	15.00
Korea, South (Won)	760.00	845.00	795.00
Kuwait (Dinar)	0.25	0.30	0.28
Lebanon (Livra)	4.00	—	—
Liberia (Dollar)	1.00	1.10	1.00
Libya (Dinar)	0.29	0.55	0.45
Luxembourg (Franc)	50.00	53.00	51.00
Malagasy Rep. (Franc)	360.00	—	—
Malaysia (Ringgit)	2.30	2.32	2.30
Malawi (Kwacha)	1.10	—	—
Malta (Pound)	0.43	0.44	0.42
Mauritius (Rupee)	11.00	14.00	12.00
Mexico (Peso)	148.00	195.00	175.00
Morocco (Dirham)	6.50	6.80	6.30
Nepal (Rupee)	13.00	30.00	25.00
Netherlands (Guilder)	2.74	2.75	2.74

YOU'LL NEED A CALCULATOR TO DO THIS ONE

WORK OUT THE
RICES IN
IAN DOLLARS

I THINK SO: THE LOWEST SINGLE ROOM PRICE FOR THE REGENT IS $520 (HONG KONG DOLLARS)
BUT SINCE EVERY $6.73 (HONG KONG) EQUALS $1 (AUSTRALIAN)
I DIVIDE $\frac{520}{6.73}$ = ____ (WITH A CALCULATOR)
SO THE PRICE IS $____ AUSTRALIAN DOLLARS.

Cost of Living Table

BUSINESS TRAVELLER'S survey on international living costs for travellers is updated regularly, making it more accurate than other compilations. It must be emphasised, however, that rapid inflation and the instability of foreign-exchange rates mean that it should be used as an approximate guide only.

The chart shows the theoretical average daily costs for a travelling executive in the major industrial and commercial cities of the country concerned. It includes a single room with bath in a first-class hotel, meals, taxes and service charges. The sum excludes any allowance for business entertainment or recreation.

Countries	Local currency
Asia and Australia	
Australia	175 Dollar
Brunei	270 Dollar
China	228 Yuan
Hong Kong	1174 Dollar
India	1144 Rupee
Indonesia	90,000 Rupiah
Japan	45,760 Yen
Korea	129,900 Won
Malaysia	380 Ringgit
New Zealand	210 Dollar
Philippines	1150 Piso
Pakistan	1854 Rupee
Singapore	438 Dollar
Sri Lanka	3032 Rupee
Thailand	3600 Baht

(CHARTS FROM 'BUSINESS TRAVELLER')

INTERNATIONAL AIRPO

Australia	A$20	Mexico	
Bangladesh	50 Taka	Malaysia	
Brunei	None	Nepal	
Burma	15 Kyat	New Zeal	
Bahrain	None	Netherlan	
Brazil	1050 Cruzeiro	Norway	
China	10 Yuan	Oman	
Canada	C$12.50	Pakistan	
Denmark	None	PNG	
Egypt	5 Pounds	Philippine	
France	None	Qatar	
Fiji	F$5	Singapore	
Greece	60 Drachma	Sri Lanka	
Germany	None	Soviet Un	
Guam	None	Saudi Ara	
Hong Kong	HK$100	Sweden	
India*	100 Rupees	Seychelle	
Israel	540 Shekels	Saipan	
Indonesia	4000 Rupiah	Spain	
Ireland	None	Taiwan	
Italy	None	Thailand	
Japan	2000 Yen	USA	
Korea	3500 Won	UK	
Luxembourg	None	Venezuela	

* 50 Rupees for departures to Afghanistan, Bangladesh, Nepal, Pakistan and Sri Lanka

1 ..$5 to Singapore and Brunei ‡ S$5 to Mala

MAKES UP A NEW TABLE
T'S HOTELS LIKE THIS

(23) COPY AND COMPLETE MY TABLE

JUST USE THE LOWEST PRICES

HOTEL	SINGLE ROOM LOWEST PRICE
1. REGENT	
2. PENINSULAR	
3. SHANGRI-LA	
4.	

I'VE GOT ALL THE INFORMATION JANET NEEDS FOR HER TRIP - I'LL WRITE IT OUT IN A REPORT

GO
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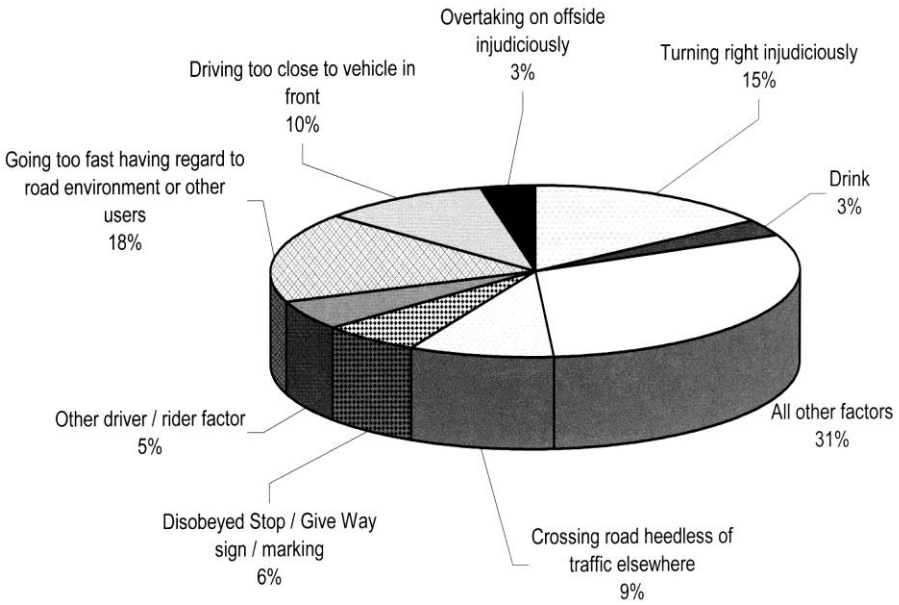
-MISP-

Road Safety

FIGURE 1. FACTORS INVOLVED IN ACCIDENTS (RESULTING IN DEATH OR INJURY) IN L.B.BROMLEY



Astronomer Jan

IX
In an Astronomical Observatory

My name is Jan and I am an astronomer. I live in Poland. My wife Anna and 13 year old son Tomek also love astronomy. Very often we look at the sky at night. When you look at the sky you can see millions and millions of stars and other things. One of them is the Sun and around the sun travels our earth, and around the earth travels our moon. When we want to see more we must go to an observatory and use the telescope there. You also find computers in the observatory to analyse what we see in space.

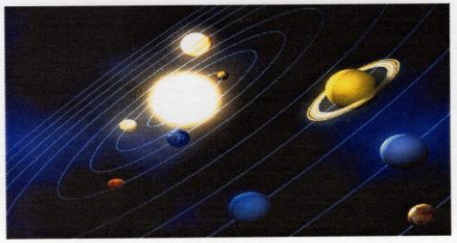
The stars and the planets are millions of years old. We need to use big numbers to describe these astronomical objects. For example: trillion years, million kilometres, billion kilograms.

The distance between two objects in space is measured using **light years.**

A light year is the distance travelled by light in one year. It is about 10 billion kilometres!!

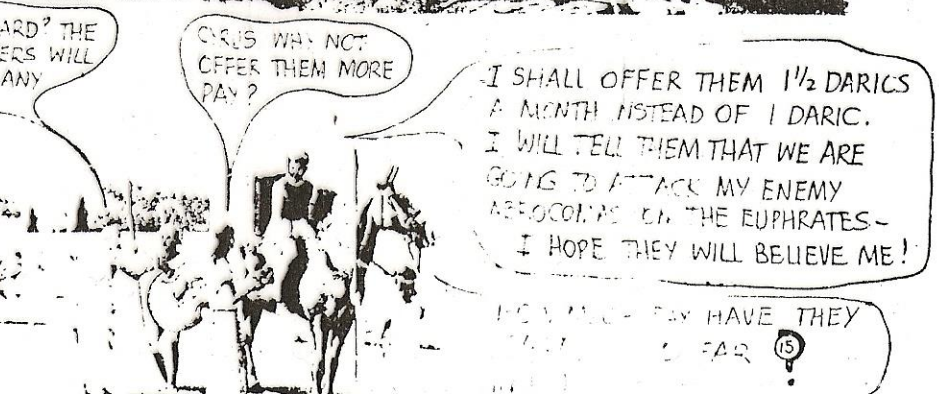
Astronomical numbers!!

In our astronomical centre we show to people models of the solar system in a scale of 1:15 miliard. This show is outside and the sun and the first 4 planets stay on the terrace but when we go to Pluto we must go for a 400 metre walk!....



AL... PALACE.

THE SOLDIERS OF CYRUS NOW BEGAN TO REALISE THAT HE MIGHT BE LEADING THEM AGAINST KING ARTAXERXES OF PERSIA.



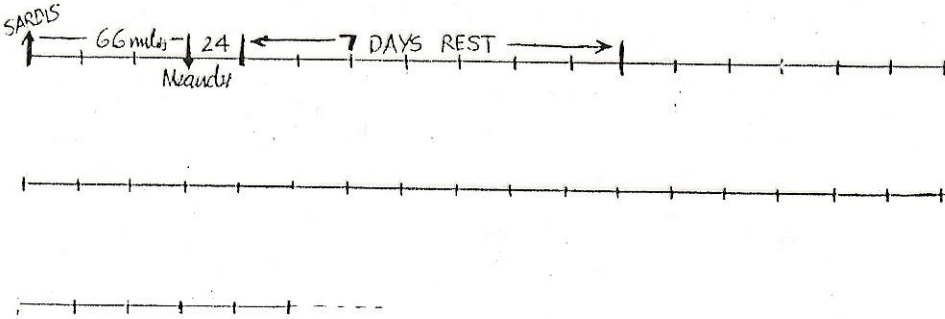
JOURNEY SO FAR

HOW MANY DAYS IS IT SINCE WE LEFT SARDIS (16)?

HOW MANY MILES HAVE WE MARCHED ALTOGETHER (17)?

SO HOW FAST HAVE THE SOLDIERS MARCHED ON AVERAGE EVERY DAY
- NOT COUNTING REST DAYS (18)?
- COUNTING REST DAYS (19)?

(20) TO HELP WORK THINGS OUT, XENOPHON DRAW A TIME-LINE LIKE
EVERY DAY IS REPRESENTED BY 1 CM. CHOOSE A FRESH PAGE
OUT XENOPHON'S TIME-LINE. LEAVE PLENTY OF ROOM FOR FILL
THE REST OF HIS JOURNEY! MARK IN THE MILES TRAVELLED EA



(21) NOW LOOK CAREFULLY AT YOUR MAP - TARSUS IS A SEA PORT
HAS YOUR JOURNEY LINE ON YOUR MAP REACHED THE SEA?
IF NOT EXTEND THE LINE TO THE NEAREST POINT ON THE COA

(22) HOW ACCURATE DO YOU THINK XENOPHON'S DIRECTIONS AND DIST

Teaching and Learning Methods

- Chalk and Talk(TV talking head)
- Group Work
- Theme Work
- Project Work
- Individualised (Independent, Programmed Learning)
- Distance Learning
- Integrated, Interdisciplinary work
- Team Teaching
- Self Learning
- Cooperative Learning

Cultural Models

- Western model
- Aborigines (Australia)
- Maories (New Zealand)
- Islamic schools and universities (Cairo)
- Multiculturalism (Bi-culturalism)
- South Africa Model (blended classes)
- Religious (Community, Hippy)

Evaluation/Assessment

- None (Rudolf Steiner)
- Continuous (implicit)
- Tests
- Exams
- Multiple Choice
- Problem Solving
- Word problems (comprehension, literacy)
- Self-evaluation
- Computer Assisted Learning
- SAG (Roberto Baldino, Brazil)

So what does the future hold for computers and education?

In 2011 the state of Florida, USA passed a law requiring that all schools switch to digital textbooks by 2015.

In the same year South Korea's Education Ministry announced a $2.4 billion investment for all of its schools to go digital by 2015 (although later this decision was put on hold).

It is not simply a question of whether we should welcome or resist such changes, that is an individual decision, but the technology will by force arrive and it is then only a matter of time before education, if possible and practicable, utilizes these new devices in schools and universities.

This is why publishers are moving towards e-publishing, and why e-commerce and e-banking are now universal.