Learning Mathematics through new Communication Factors
A European Commission Funded Project (Comenius MP) running from November 2012 to October 2014
526315-LLP-2012-CY-COMENIUS-CMP

Le-MATH
Learning mathematics through new communication factors

A European Commission funded project

(under Comenius MP)

2012-2014

SCIENTIX Conference

WORKSHOP , Brussels 26 October 2014

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WORKSHOP OUTLINE (in steps)

1. **Presentation of the Le-MATH project**
2. **The methods**
3. **Assessment/evaluation tools**
4. **Samples of MATHeatre video plays**
5. **Sample MATHFactor video play (practice assessment together)**

Workshop participants become the jury (use Le-MATH marking paper).

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STEP 1

Rational…what is the problem?

Many pupils and parents consider mathematics

- As a difficult and a boring subject
- Abstract and non-approachable
- Many pupils instead of studying mathematics prefer to spend most of their time watching TV or playing electronic games or exchanging messages with their mobile phone, exchanging pictures, exchanging videos, competing etc.

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How can we bring pupils back to the "playing field" of education?

- One way to achieve this is to use similar tools ("weapons") as the "opponents".
  - In simple words, to communicate the learning of mathematics in a non-traditional way, like a game through theatre or competitions similar to the well-known X-Factor and other.

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- This project introduces completely different and new approaches
  - Invites teachers and pupils to apply new communication methods in learning mathematics, which could be fun and enjoyable at the same time.
  - Brings new ideas under “play and learn”.

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- Le-MATH is:
  - Proposing new methodologies in learning and teaching mathematics to pupils of age 9-18, which can be used in any school environment for Making learning more attractive and enjoyable for all pupils
  - Enhances students' skills for creative thinking.
- The methods could be used for other subjects of the education curricula and for other ages.

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- The use of theatre and oral communication is proposed with guidelines as a methodology in teaching and learning mathematics with the creation of support tools that can be used by teachers and pupils.
- The methods are created in such a way so that they can be explained practically through an in-service training course for teachers who teach mathematics to pupils of age 9-18. Therefore the two methods are named:
  - A. MATHeatre: Teaching and learning mathematics through math theatre activities
  - B. MATHFactor: Teaching and learning mathematics through oral mathematics communication activities

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- Pilot Phase : September 2013 – April 2014

Teachers and pupils were invited to use the method through the Version 1 of the guidelines(published in September 2013) and participate in the European competitions for MATHeatre and MATHFactor.

The teachers and pupils were asked to participate in an evaluation process, which has produced a report of 170 pages. This report has helped to modify and improve the guidelines available to you today.

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- The project results contribute among other to:
  - The Education and Training 2020 for enhancing **creativity and innovation** among youth.
  - The benchmark for **decreasing low-achievers** in basic skills (mathematics and science) to less than15%.
- It promotes the European Cooperation on schools in the area of competences by supporting and promoting the key competence for mathematics.

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Project main outputs and tools

1. Guidelines for the MATHeater method (printed, pdf, interactive)
2. Guidelines for the MATHFactor method (printed, pdf, interactive)
3. Manual of Good Practices for MATHeatre (web-based with analysis)
4. Manual of Good Practices for MATHFactor (web-based with analysis)
5. Book: "Mathematical Stories for Theatre"
6. Manual of Scripts for MATHeatre (based on a Script writing competition completed in 2013 (40 scripts from 13 countries worldwide included)
7. Manual of Scripts for MATHFactor (developed by the partners)
8. A course programme for training teachers with specified key learning outcomes Developed and planned

   1st Le-MATH European course , 4-10 December 2014, Protaras, Cyprus

   2nd Le-MATH European course, 25-31 March, 2015 , Athens, Greece

Connect to Le-MATH site

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- # Project partners and participants

1. Cyprus Mathematical Society(CY- Gr. Makrides, A. Philippou, C. Papayiannis)
2. Thales Foundation of Cyprus(CY- A. Skotinos, P. kenderov, E. Christou),
3. Charles University in Prague-Faculty of Education(CZ- J. Novotna, A. Jancarik, K. Jancarikova, J. Machalikova),
4. Loidl-Art (AT- H. Loidl),
5. VUZF University(BG-S. Grozdev),
6. "CALISTRAT HOGAS" National College Piatra-Neamt (RO-N. Circu, L-M Filimon),
7. Lyckeskolan (SE- M. Lydell Manfjard),
8. LEOLAB (ES- M. Munoz),
9. Junior Mathematical Society Miskolc(HU- P. Kortesi),
10. European Office of Cyprus(BE-CY- R. Strevinioti, D. Tsikoudi),
11. Collège Saint Charles(FR- K. Treguer, E. Gueguen, E. Darees),
12. National Technical University of Athens, Institute of Communication and Computer Systems(GR- K. Karpouzis, A. Christodoulou),
13. Com2go Ltd(CY- G. Economides, N. Nirou).

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- STEP 2 The MATHeatre method

Why Mathematics Theatre?

- The idea is to make the study of mathematics more attractive through theatre.
- Theatre activities in maths education have the potential to act as an important tool for development of students' comprehension, encouraging their motivation and diminishing their preconceptions that mathematics is too abstract. The use of these activities in mathematics teaching can help teachers make maths lessons more enjoyable both for students and themselves.
- Suggested scripts and concrete examples of theatrical experiences are available in the Le-MATH Guidebooks and in the Le-MATH Manual of Good Practices.

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Past-Present-Future

- Since ancient times great mathematicians have used oratory to communicate their knowledge. Through the rhetoric and the forum, they shared their knowledge and enabled the diffusion of major theories. Also staging concepts and characters would allow our students a better understanding of concepts that seem often intangible.
- Theatrical techniques are often used in special pedagogical or socio-cultural situations such as the learning of a foreign language, for personal development, or to aid enthusiasm of a group, so why not in a mathematics session?
- The universality of mathematics allows every mathematics teacher to use such a method, as a tool to succeed in teaching their subject.
- You will be able to write your own scripts or use published ones.
- The teacher becomes the stage director. In this way you can create dynamism in the group where each student can exchange ideas, give input, listen and share with the pleasure of working together.
- Each student can also develop a socio-cultural awareness, autonomy, an open mind, imagination, creativity and self-discovery with the help of the teacher and learn to cope with the experience of performing in public and improving their self-confidence and self-expression.

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- Theatre reinforces the notions of sharing and collaborative learning. Acceptance of authority is integrated in a playful frame. Given instructions are more easily accepted.
- That's why the creation of communication situations and a real exchange (initial preparatory work in the class, rehearsals, final production, and the performance) around a mathematical theme, as a pretext to using a specific language can be practised in a theatrical context.
- Students will learn to bring out, unlock and fluidize their speech, improve their memorization during rehearsals, and will be enabled to think and reason by using the language of mathematics, rendering this subject less “foreign” by working intensively with it. This approach will consolidate learning, enable work on rhythm, melody and intonation, sounds and tonalities (Multiple Intelligences: musicality), learning in general and especially for younger children there will be improvements in attention, concentration and listening to each other.
- Theatre is an art which mixes, amongst others, music, dance, comedy, and leads to a discovery of the related jobs of sound control, lighting, set building, costumes, make-up...
- And more than that...the pleasure, the game!

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That is the reason why teachers need to take account of the following points in order to succeed:

- **The first point should be the heterogeneity of groups**

- Just in case…

There may be students who still resist this technique itself: students who don't like theatre, who are too shy or have other reasons for refusing to be actors: (Fear of being ridiculous, fear of being judged or a fear to deceive the learners.)

They can still be involved in other important roles bringing out their strengths as offering technical support, writing, directing, costume, set, makeup and so on.

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Other points for teachers:

- The aim of such activities is not that they should be carried out continuously throughout the year but maybe once, or as a workshop where you are not confined by the curricula.
- Some teachers worry about a lack of training or information in these practices: There may be different problems to deal with than those we are used to in the classroom: too much noise, disturbances, excitement from the young ones.

So what qualifications are needed to begin this theatre practice?

- It is certainly an advantage if the teacher has had experience in theatre but it is not necessarily a requirement. Most people have seen at least one play or have read a play.
- It is not so difficult for teachers to become actors or stage directors: We teachers are like actors on stage as soon as we enter our classroom! We have our "public" and we must convince our "audience" of the truth of our knowledge using rhetoric, drama etc. Just in the way that famous mathematicians, thinkers or philosophers have done for centuries...
- The role of the teacher is to create a fun atmosphere beneficial to the game, to reassure the learners and to encourage their participation. The teacher needs to instil a sense of mutual respect, to establish a non-judgemental atmosphere where humility and collectivism are important as well as allowing imagination to thrive.

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Different types of theatrical activities

- It is possible to set up a theatre activity in the mathematics lesson in different ways depending on the objectives, but also depending on the number of sessions the teacher chooses to use for the work.

a) To discover a new concept:

- The setting of a theatrical activity can help the teacher to introduce a new concept. In this way, the teacher can prepare a discovery activity that will allow students to become familiar with new content.
- Role plays are appropriate to explain mathematical methods where each student has a specific role in the game, e.g. exploring proper or improper fractions and mixed numbers, simplifying fractions, or solving equations …
- Pallascio and Lajoie (2001) study role-playing as an efficient tool for making students active in a given situation. The objective of theatre activities, similarly to role-playing, when used in teaching contexts, is to lead student-actors and other student spectators to learn something from the given situation. When dramatizing a mathematical concept, pupils use facial expressions, role-playing, improvisation etc. They work in groups and improve their understanding of mathematics through writing scripts and playing the theatre.
- The activity is conducted before the lectures. Its length is relatively short.

b) To reinvent a concept:

- The use of theatrical activity could also be used after studying a concept following the theory and the classical training exercises. Acting a play or writing a script is a good way to master a concept.

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- **Theatrical approach**

in the classroom (read the guidelines)

- **Theatrical approach**

on a real stage (read the guidelines)

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- **Before writing a script**, it's useful to look at theatrical terminology -(**read the guidelines**)

Many examples of scripts in the Guidebook, the Manual of Scripts, the Book Mathematical Stories for theatre. Free to download.

Ideas for Costumes (read the guidelines)

Feedback

- Discussions between the student-actors and the student spectators about the mathematical notion or the play are a good way to verbalize and clarify any difficulties.
- Self-evaluation: videos can be used and are a good way to realize the mistakes and help the students improve.

Useful templates (profile of play in class, record sheet for teachers) – (read the guidelines)

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MATHFactor method

Why Mathematics Communication?

- Improving communication skills is very important as these are a form of social skills. The communication of mathematical ideas requires a special approach as the theories initially seem abstract or symbolic and oral explanation is sometimes problematic. Learning to communicate mathematical theories orally is a positive challenge for teachers and pupils.

- Communicating with classmates, communicating with the teacher or communicating with a non-specialist audience brings many advantages to school pupils. The self-esteem and confidence of the pupils will increase, which will assist them later in life in job searching and in many professions such as teaching, researching, reporting, managing, marketing, etc.

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Why communicate mathematics to the public?

- **To promote a mathematically and technology literate workforce**
- **To enable citizens to play an informed role in their democracy**
- **To ensure that mathematics are an integral part of everyday experience**

Important attitudes to mathematics to be considered during communication of mathematics:

- **Fascination**: -seek out mathematics in the media
  - I am amazed by mathematics and how its application is making our lives healthier and safer
- **Tolerance**: -passive but generally supportive
  - Mathematics is making our lives easier and more comfortable
- **Fear**: -distrust of motives of mathematical scientists and their funders
  - Rules will not stop researchers doing what they want behind closed doors
- **Indifference**: -low priority concern, out of reach
  -Mathematics is too specialized for most people to understand it

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Mathematics Communication Factors for learning mathematics in the school environment and beyond

Motivation

What is the motivation?

- It is the force that activates and addresses the behaviour
- It is the fuel that allows us to carry out what we propose

"*If we want to build a ship, it is not enough to get a group of workers together and give them instructions and distribute the work to them. We must inspire them to want to discover the far seas.*"

by Antoine de Saint-Exupery

For what motivation is useful?

- An individual on many occasions needs a stimulus or a "booster". Motivation acts as such, in order to encourage us to fulfil our aims or to satisfy the needs of the person. For this reason motivation is useful to stimulate someone to do what they need to or should do for their own benefit and that of others.
- (more details on motivation in the guidelines)

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Content

The field of mathematics is very wide and its applications are unlimited. Content which may be particularly useful, for a short oral presentation could be:

- Abstract mathematics to make it easier to understand using paradigms and parallels from everyday life
- Applications of mathematics that explain how science and technology work and how mathematics is involved.
- The explanation of physical phenomena using simple mathematics
- History of mathematics and story about mathematicians

Many such examples can be viewed in the You-tube video data base for MATHFactor 2012, 2013 and 2014 found in the sites, www.euromath.org and www.le-math.eu

- Basically, almost any topic of the curriculum could be used , as long as we are creative enough to communicate it in an interesting and attractive way.

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A. Verbal and Non-Verbal Communication

- Know your audience
- Use the room as a stage
- Prepare
- Speak loudly and clearly
- Modulate the tone, pitch, and speed of your speech.
- Use gestures and facial expressions to help you explain, emphasize, and communicate.
- Develop a presentation persona.
- Show passion and enthusiasm for the topic.
- Do not read your notes or slides.
- Interact with and pay attention to your audience.
- Do not take yourself too seriously.
- Keep track of the time.

B. Effective Use of the Visual-Aids in the concept of a classroom

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C. Effective and Meaningful Organization of Content

- Plan the content.
- Provide a structure.
- List objectives or provide an outline at the beginning of the presentation.
- Organize the content with a theme or storyline.
- Allow for pauses and “wait-time.”

D. Dealing with presentation nervousness, especially in live presentations

- Its ok to be a little nervous
- Breathe
- Hold on to something
- Go slow
- Trust yourself

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Making a presentation

- Research your audience
- Prepare your talk
- Audio-visual aids
- Rehearse [but not forever]
- How to behave and move
- Keep it varied
- Use illustrations

Being filmed or recorded

- Where to look
- Arm waving
- What to wear for TV
- Get comfortable
- For Radio, consider Scripts

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Attracting Media attention when public event is organized

The journalists' questions

- Who?
- What?
- Where?
- When?
- Why?
- How?

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STEP 2 The Guidelines for the Methods

- MATHeatre Guidelines 
- MATHFactor Guidelines 

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Step 3

- Assessment/Evaluation tools

MATHeatre

MATHFactor

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Step 4

- Sample MATHeatre video play

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Step 5

- Sample MATHFactor video
- Workshop participants become the jury (use Le-MATH marking paper).

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We thank you for your participation and we hope you have enjoyed it

Contact details

www.le-math.eu

info@le-math.eu

www.euromath.org

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