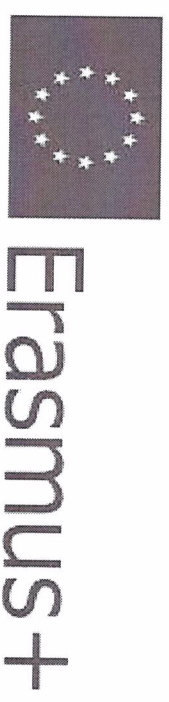


Guidelines promoting the designing of lessons in Mathematics with the support of Programming in Secondary schools



INTRODUCTION

Presentation and intended outcomes

These guidelines are envisioned to support development of skills in designing, implementation and evaluation of Math lessons with the support of Programming. The guidelines are intended for teachers who want to go one step further, by not only using the lessons presented by the Erasmus+ ProgMath project, supported by the on-line users' instructions. This way Math teachers are invited to contribute to further development by designing their own lessons and share them with other Math teachers.

Lessons made using the methods and documentation described in these guidelines, will be presented together with the already produced model lessons on the project's website, after having been reviewed by members of the project group. They will thus be published and are expected to generate knowledge development and provide additional support to colleagues around Europe.

The basis for the development of lessons

The creation of the model lessons is based on collaborative peer-to-peer learning and development. The creation method is built on Design Thinking, using group dynamics and support in testing each other's ideas and results to enable a cyclical process for improvement. During the project the participating teachers have been working in triads, nationally and transnationally, but working in pairs or in bigger groups is also possible.

The framework set out for the lessons is that the lessons must support the implementation of Programming as a part of the Math curricula and that they must follow the Kolb's learning cycle. The lessons therefore vary, using different programming languages and addressing different age groups from lower secondary to upper secondary schools. Some lessons are intended for the beginners and some for the very advanced, some lessons are also intended for the extra talented students. The lessons are supported by an online course with modules adapted to different programming languages.

The working process follows a pre-created template that is created by the project participants using the same principles of collaborations as for the lessons. The completed template also makes up the actual final model lesson, including a teacher guide, a so called "recipe card".

Design thinking

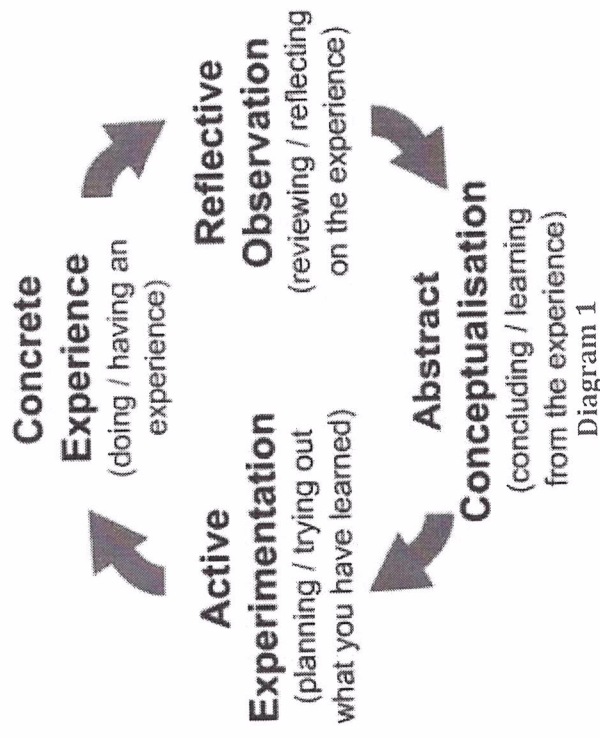
Design Thinking is a method that provides a solution-based approach to solving problems. It is an innovative, creative and human-centered process and mindset using collaborative multidisciplinary teams in order to generate user-focused products. It promotes knowledge building through innovation, problem solving, creativity and collaboration. The creativity process conducive towards creating confidence and positivity as it is non-judgmental and eliminates the fear of failure and is thus contributes to a high degree of participation.

The process is built on six steps:

Steps		Educational context
Empathising	Understanding the human needs involved	Understanding the needs of teachers and learners on different levels and with varying experience
Defining	Re-framing and defining the problem in human-centric ways	Describing what is needed to achieve the goal of providing model Math lessons with the support of Programming adapted to the needs of the users
Ideating	Creating many ideas in ideation sessions	Collaborative brainstorming sessions
Prototyping	Adopting a hands-on approach in prototyping	Using the ideas from the brainstorming sessions to design model lessons based on the needs of teachers and learners with concrete teacher instructions
Testing	Developing a prototype/solution to the problem	The teachers in the designing group test the lessons in real life and preferably the lessons are tested by other teachers adjusting and redesigning the lessons using the testing feedback and reflections
Implementing	Put the vision into effect	Publish the model lessons for general use Using the lessons in schools

Kolb's learning cycle

Kolb's approach synthesizes goal-directed and behavior learning theories to create a learning cycle which values process and the ongoing nature of learning. The Kolb learning cycle is typically represented by four stages through which the learner repeatedly progresses.



Kolb's model highlights the importance of the reflection component in the learning cycle. Reflection allows the student to process what just happened during the experience. In the Reflective Observation stage students can both recount and evaluate their experience. This cataloging provides the information necessary for the next stage: Abstract Conceptualization. At this second opportunity for Critical Reflection, students explicitly link their experience with their preparatory learning, their expectations, and the outcome of the experience. Only through the reflection process can the experience be truly transformational, as the knowledge students carry into the learning activity is evaluated in terms of their personal experience. The final Reflection component for Kolb happens in the Active Experimentation stage. Here, students use reflection to create plans for further learning experiences. (University of Puget Sound)



The ProgMath designing process

