Kitchen Lab 4 Kids
Project description

K4K playground

STEM in preschool

Preschool kitchen

Core STEM skills

K4K

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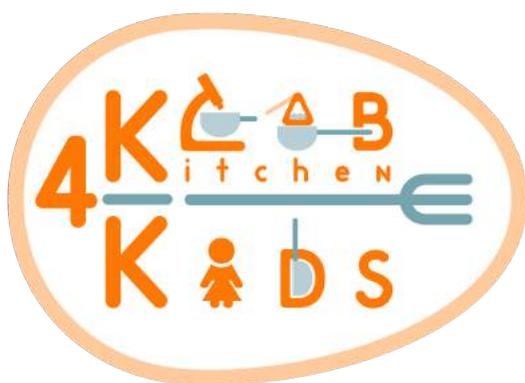
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K4K playground

The idea of STEM education - its origins, and searching for XXI century solutions

Do you know what is STEM education?

STEM education is an approach that intends to teach Science, Technology, Engineering and Maths as an integrated whole, covering the entire development from early childhood to higher education (Bybee, 2010). Scientific literacy implies providing students with a set of tools that help them interpret and answer to science found in everyday life. It emphasizes, for example, health and the environment (Vincent-Lancrin, Kärkkäinen, & Avvisati, 2011).

What are the benefits of this perspective?

STEM education develops human cognitive capital (knowledge, abilities and capacities) and brings to light non-cognitive characteristics such as work values (Carnevale, Smith, & Melton, 2011). It has also been linked to future scientific leadership and prospective economic growth (National Research Council, 2011).

A bit of history...

The US National Science Foundation first aroused the STEM acronym (Kumtepe & Kumtepe, 2013). It was prompted by the need to raise citizens capable of contributing to the economic and cultural competency in the information era (Moomaw & Davis, 2010). Research in the STEM field is incipient compared to that in curriculum development and student's performance (English, 2016). Even though the early introduction to STEM subjects is being discussed recently by researchers, major propositions for national regulation, curriculum development, teacher preparation, and setting standards are still lacking (Akgündüz et al., 2015).

But… why STEM education?

It is claimed that knowledge and skills from STEM disciplines are increasingly required in jobs at all levels, with a tendency on the rise. The STEM disciplines should be integrated as a whole: its effectiveness should come from integration of science and math skills into an engineering or problem solving process that entails utilization of developmentally appropriate technologies (Merril & Dughery, 2010).

Studies derived from PISA Informs demonstrate the correlation between the development of STEM competencies and innovation (OCDE, 2015). However, innovation based on science and technology is impossible without a working force educated on Science, Technology, Engineering, and Mathematics (Atkinson & Mayo, 2010). Improvement in early childhood teacher's education is required.

At the end…

Teachers have the last word: we mean that student's performance on tasks depends on multiple incentives, and effort and motivation are fundamental for greater achievements and cognitive development. It has been proved that relevant experiences promoting cognitive, physical, social and emotional development in early childhood have an impact on future stages' results (Chetty et al, 2011). It is the most permeable period when learning. Teachers are of primordial importance and the need to optimize their contribution has been endorsed at European level as a priority of politics of education (European Comission, 2015).

STEM in preschool

Introducing STEM Education at the Preschool Level: Possibilities of Developing Scientific Thinking in Young Children

STEM experiences begin informally at an early age as children navigate their world, engaging in:

- hands-on activities

- testing and problem-solving

- decision-making

- sense-making

- creative activities

There is an opportunity to build on these early STEM experiences by introducing STEM education formally at Preschool. STEM being a multi-disciplinary approach provides the opportunity to develop a range of skills and abilities in children, all of which are necessary in navigating the world today. These include:

- exploring
- questioning
- planning
- communicating
- designing

- making
- analysing
- evaluating
- creative problem-solving

Developing these skills and abilities promotes and develops scientific thinking in children. Metacognitive skills are key to the process of scientific thinking, as well as being crucial in life-long learning. Therefore, promoting scientific thinking through STEM in Preschool years encourages children to apply STEM skills and abilities to solve everyday problems.

Preschool kitchen

Preschool Kitchen as a Laboratory for STEM education - possibilities and challenges

The *KLab4Kids* aims at proposing interdisciplinary activities in an integrated teaching context that allows pre-schoolers to develop STEM skills while practicing exciting science at the same time. One of the goals of the project is to develop **innovative didactical materials** (also through re-use of resources) **stimulating group processes** among children, **increasing motivation** and achievements in science learning through kitchen laboratory.

The *KLab4Kids* project is focused on **student-centred and problem-based active learning**. This multidisciplinary and inter-disciplinary approach fosters critical thinking skills by addressing cultural and/or environmental contexts in teaching science through kitchen activities.

The project *KLab4Kids* organizes cooking classes during which children can handle vegetables, meat and other food products in the preparation of meals. This experience allows children to become confident with the basic STEM concepts such as **measuring, weighing, timing, combining ingredients, cooking and heating procedures**.

Through **formal and informal activities**, which can be carried out at school or at home with parents. Inquiry-based activities allow children to acquire new communication skills through question and answer activities with the teacher. The *KLab4Kids* nurtures preschool children's STEM skills while providing opportunities to build children's executive function skills. These skills include organizing information, staying focused, strategizing, planning, and exercising self-control (US National Center on Learning Disabilities, 2014).

The *KLab4Kids* project represents a challenge to pre-school teachers who are involved in the teaching of STEM skills through innovative and cooperation-focused practices. Through the kitchen-lab experience, teachers can cooperate with each other to create learning units and plan activities to effectively support the cognitive development of pre-school children, and exchange good practices. Thanks to this lab, teachers can create a **community** inside the school focused on the use and creation of materials for learning STEM skills.

Learning by doing is the leitmotiv of KLab4Kids pedagogical approach, based on the personal investigation, that helps pupils develop cognitive processes as well as the sense of curiosity and creativity.

Core STEM skills:

Learning to think and discover

🥚 Creative thinking

　🐣 Fluency of thinking

　🐣 Flexibility of thinking

　🐣 Originality of thinking

　🐣 Sensitivity to problems

　🐣 Elaboration

🥚 Critical thinking

Mathematical reasoning

🥚 Scientific thinking:

　🐣 Asking questions

　🐣 Analyzing and solving problems

　🐣 Designing experiments

　🐣 Conducting research - predicting, testing hypothesis, observing, experimenting

　🐣 Drawing conclusions based on evidence, reasoning

　🐣 Using digital tools do conduct and document research

Other skills:

Learn to move graciously

🥚 Large and fine motor skills

🥚 Hand-eye coordination

🥚 Precise and efficient movement

Learn to work in a team

🥚 Taking common decisions

🥚 Sharing ideas: negotiating meanings

🥚 Sharing responsibility for a task

🥚 Accepting leadership and management

🥚 Following the safety rules and discipline

Learn to use language

🥚 Basic literacy: reading, writing, listening with comprehension

🥚 ICT literacy: using computer to communicate with others

Core STEM skills include two essential groups of abilities:

A group of cognitive skills called "Learning to think and discover". These are the abilities underlying the problem-solving ability, such as: identifying the problem/ realizing the gap in one's own knowledge

and becoming curious about it, formulating the precise question, predicting the possible answers (hypothesis), designing the procedure necessary to check the predictions (to test the hypothesis), conducting research, observing the results, and drawing evidence-based conclusions etc. All these are crucial ingredients of so called "**scientific thinking**" - precise, logical, evidence-based reasoning underlying every scientific procedure, both inductive and deductive. An important areas of such thinking are also:

🥚 **Creative thinking** - a thought process used to generate new ideas while exploring many different possible solutions. Divergent, non-linear reasoning is usually activated while coping with open questions which force the learner to go beyond the stereotypes, find unexpected connections, think outside the box, instead of searching for an algorithm (or cognitive schema). Important qualities of divergent thinking are described by J.P. Guilford as:

- **Fluency of thinking** - the ability to generate many ideas in a certain period of time (the speed of inventing new ideas);
- **Flexibility of thinking** - the ability to come up with different types of answers underlying the adaptability being ready to change the direction of thinking;
- **Originality of thinking** - the ability to invent unusual, non-stereotypical ideas which allow the person to look at the problem from a different, unexpected, surprising, metaphorical perspective;
- **Sensitivity to problems** - a questioning attitude, ability to perceive disadvantages, shortcomings of objects, possible problems or barriers in actions, inconsistencies or gaps in data etc.;
- **Elaboration** - the amount of effort invested in presenting the creative idea (clarifying, explaining, embellishment, saturation with details, correcting one's own work to etc.)

🥚 **Critical thinking** - reflective, evaluative, judgmental attitudes towards the knowledge statements - the ability to undertake critical reflection in the process of understanding and creating knowledge. "*A process that involves asking appropriate questions, gathering and creatively sorting through relevant information, relating new information to existing knowledge, re-examining beliefs and assumptions, reasoning logically, and drawing reliable and trustworthy conclusions. Critical thinking calls for a persistent effort to apply theoretical constructs to understanding the problem, consider evidence, and evaluate methods or techniques for forming a judgement. The cognitive skills of analysis, interpretation, inference, explanation, evaluation, monitoring and correcting one's own reasoning are at the heart of critical thinking*" (IBE, p. 15).

🥚 **Mathematical reasoning -** the ability to use mathematical concepts and disciplined thinking to solve everyday problems, to perceive the reality as internally organized, based on the concepts of number, quantity, frequency, patterns, internal rhythms etc. They include: precision and logic in managing quantitative data (counting, calculating, measuring, classifying), but also the ability to represent ideas in a mathematical way (create patterns, models, theoretical constructs, tables, graphs etc.).

Please note, these skills are naturally intertwined, inseparable, interacting or conditioning each other. They were separated only on theoretical level of description to illustrate the most important aspects of

STEM education. A good example of such interaction is the **ability to use digital tools to conduct and document research, present their results or communicate with others, to share knowledge, create the culture/ or environment of thinking** This ability may be perceived as a separate set of skills (e.g. searching for information, comparing data from different sources, selecting the most important pieces of the search, using popular applications etc). In STEM education however, such skills are embedded in a broader process of conducting scientific experiments, exploring the reality around with the practical use of digital tools. Computer and ICT technology becomes here an important tool of thinking - helpful, but external, complementing the capabilities of the human mind rather than replacing/ substituting them.

A group of abilities related to self-regulated learning - represented in the Matrix as „Learning to learn". These are the combination of cognitive, metacognitive and emotional skills described in EU documents (Hoskins, Fredriksson 2008) as a reference to all cross-cultural measures of competence in learning, e.g. PISA tests. The official definition of „Learning to learn" was offered by European Council in 2006 - „*the ability to pursue and persist in learning, to organize one's own learning, including effective management of time and information, both individually and in groups. This competence includes awareness of one's learning process and needs, identifying available opportunities, and the ability to overcome obstacles in order to learn successfully. This competence means gaining, processing and assimilating new knowledge and skill as well as seeking and making use of guidance. Learning to learn engages learners to build on prior learning and life experiences in order to use and apply knowledge and skills in a variety of contexts: at home, at work, in education and training"* (Education Council, 2006 annex, paragraph 5). Self-initiated, self-regulated, independent, intentional learning has become the key to personal and professional development in the contemporary world.

There are 3 crucial dimensions of "Learning to learn" ability, as described by Hoskins and Fredriksson (2008, p. 28-28):

- **The affective dimension comprises such elements, such as:**
  - **motivation to learn and engage,**
  - **academic self-concept and self-esteem** - positive self-image as a learner, ability to recognizing one's own strengths and dispositions in the learning process;
  - **the feeling of self-efficacy** based on previous positive experiences, achievements and successes in learning;
  - **emotional resistance** - the ability to cope with stress and negative feeling which might occur while learning
- **The cognitive dimension is based on executive function** and the effectiveness of basic cognitive processing,
- **The metacognitive dimension** comprises such abilities as: planning one's own learning, monitoring the course and effectiveness of learning process, evaluating the achieved results etc. All these abilities are the prerequisites for achieving the **cognitive autonomy** and **becoming a self-regulated learner**, independent in thinking and making decisions, however able and eager to search for educational support in social environment if needed.

Learning to learn abilities are often disrespected or not taken seriously enough in preschool education, perceived by many teachers as „too difficult" for young learners. STEM education allows to include these abilities as a natural elements of everyday learning.

Please note: We decided to use the term "skills or abilities" instead of competencies for two reasons:

1. Preschool core-curricula of partner countries concentrate on skills defined as „the ability, proficiency or dexterity to carry out tasks that come from education, training, practice or experience" (IBE 2013, p. 53). Skill is the ability to perform actions which achieve a desired outcome.

2. The concept of „competence" is much broader, going beyond the knowledge and skills. The Council of Europe (1997) proposed that competence should be regarded "as the general capability based on knowledge, experience, values, dispositions which a person has developed through engagement with educational practices" (p. 26). Therefore, the concept of competence „is not limited to cognitive elements (involving the use of theory, concepts or tacit knowledge); it also encompasses functional aspects (involving technical skills) as well as interpersonal attributes (e.g. social or organizational skills) and ethical values" (IBE 2013, p. 12). The great benefit to a concept like "competence" is that it directs our attention beneath the observable behavioral surface of "skills" to inquire into the mental capacity that creates the behavior. And it directs our attention beyond the acquisition of 'knowledge' as storable contents (what we know) to inquire into processes by which we create knowledge (how we know)" (Hoskins, Fredriksson 2008, p. 11). Considering the above, we concluded that achieving the competence at an early stage of life is quite impossible.

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Website

For further and updated information about this project please see: http://kitchenlab4kids.eu/

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K4K - Kitchen Lab 4 Kids is an Erasmus+ KA2 project (2018-2021). The project aims at proposing interdisciplinary activities in an integrated teaching context that allows pre-schoolers to develop STEM skills while practicing exciting science at the same time.

Partnership:

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