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*Efstathios Mavrotheris, Maria Meletiou-Mavrotheris*

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## **SMASH: An Innovative Training Approach for Parent Education in Mathematics and Science**

**Efstathios Mavrotheris<sup>1</sup>, Maria Meletiou-Mavrotheris<sup>2</sup>**

<sup>1</sup>Open University of Cyprus

<sup>2</sup>European University Cyprus

mavrotheris@ouc.ac.cy, m.mavrotheris@euc.ac.cy

### **ABSTRACT**

*Acknowledging the central role of parents in children's learning, the recently EU-funded Grundtvig Action Project SMASH (Lifelong Learning Program 2007-09) aims to raise the educational standards of European youth in mathematics and science by cultivating underlying home cultures as springboards for learning. The project consortium will develop, pilot-test and deliver an innovative intercultural parent-trainer training course and related resources for professionals involved in parent education initiatives. The course will provide these professionals with current knowledge, techniques, and implementation tools for the provision of high-quality, culturally differentiated training in mathematics and science education to parents of elementary and middle school children (ages 6-15) in their communities. Online multilingual resources will support and promote the program's activities and objectives by offering open access to the parent-trainer training course content and tools.*

**KEYWORDS:** *Mathematics, Science, Parent education*

### **RATIONALE OF AND BACKGROUND TO THE PROJECT**

In technology-based society, where mathematics and science provide essential knowledge tools and the foundations for more advanced or specialized training either in higher education or through lifelong learning, several studies indicate the lack of mathematical and scientific competence of a considerable proportion of both the adult and student population around Europe (IALS, PISA, TIMSS). Research also indicates that pupils with poor quantitative skills are likely to have fallen behind by the age of ten. Thus, if the European Union is to achieve the objective set by the European Council for a considerable increase in the number of European college-level students graduating in mathematics, science and technology and pursuing technical careers, it should put more focus on improving student achievement in mathematics and science at a young age (Commission of the European Communities, 2007).

Significant reform efforts in mathematics and science education are occurring at both the European and national levels. It has been recognized that the core of school mathematics and science should no longer be the teaching of techniques and calculations that computers can do much faster and more reliably, but the development of problem-solving skills that students will need to effectively live and function in a highly complex society. Numerous initiatives are underway aimed at raising the quality of teaching and learning through the development and implementation of pedagogically

sound, technology-based tools and curricula. Despite their usefulness, these initiatives tend to focus on formal education systems and to underestimate the influence of the informal learning occurring outside school. In particular, while teachers are being offered professional development opportunities on pedagogical and technology trends in mathematics and science education, no analogous opportunities are being offered to the other important stakeholder in improved education-parents.

Parental involvement is key to a child's achievement. The research literature indicates a very strong positive relationship between school performance and a conducive to learning home environment (Kellaghan et al., 1993; Carter, 2002; Downey, 2005). Given the fundamental changes that have occurred in both the content and pedagogy of mathematics and science, the majority of parents do not have the needed knowledge to create an environment within the home that fosters their child's development and is coordinated with classroom work. Moreover, most parents lack the necessary knowledge to guide their children towards constructive uses of technology in support of their learning and developmental needs (Becta, 2001). As a result, although the majority of children in Europe have access to a computer at home (Ramboll Management, 2006) and spend far more time using ICT than they do at school (Becta, 2001), computers are not utilized constructively. Rather, children often use technology at home for non-educational purposes such as playing computer games (Mavrotheris et al., 2004).

Parent education is considered an "essential component" of successful parental involvement (Freedman & Montgomery, 1994; DiCamillo, 2001). To spur reform in mathematics and science education, parents should be provided with guidance on how to enhance their children's learning experiences.

### PROJECT OBJECTIVES

SMASH (Success in **M**ath and **S**cience at **H**ome) is a project recently funded by the European Union under the Lifelong Learning Grundtvig action that was proposed in response to the need for reaching out to parents and informing them about new developments in mathematics and science education. The project consortium is comprised of seven partner institutions in five European countries (Cyprus, Greece, Spain, Czech Republic, and UK).

The overall aim of the program, which will run for two years (December 2007-November 2009), is to offer high-quality training to parent educators around Europe that will equip them with the required knowledge, skills, and resources to provide professional guidance to parents of elementary and middle school children (ages 6-15) in how to best support their child's development in mathematics and science. More specifically, the project has the following objectives:

- a) Developing, pilot testing, and offering an *intercultural parent-trainer training course* for European teachers, school administrators, representatives of parent associations, and others involved in training activities for parents, that will prepare them through combined use of e-learning and physical meetings to implement in their communities *culturally differentiated parent-training programs* for supporting children's development in mathematics and science.
- b) Developing, pilot testing, and distributing to parent educators for use in their

parent-training programs *a culturally differentiated training pack for parents* offering technology-enhanced, research-based educational aids and resources for parents to support the development of their children's mathematical and scientific knowledge and skills.

- c) Designing and developing *a multilingual knowledge base* to support and promote the program's activities and objectives by offering open access to the parent-trainer training course content and pedagogical approach, to the parent training pack, and to various other links and resources.
- d) *Initializing networking among parent educators across Europe* by building an online community for the exchange of ideas, content, tools, and didactic approaches relating to parent education in mathematics and science. The long-term objective will be to sustain and, if possible, to expand this community into a pan-European network of communication.

### PEDAGOGICAL AND DIDACTICAL APPROACH

The theory of learning we espouse is social constructivism. The design of the parent-trainer training course currently under construction is being based on the importance of dialogue and collaboration between teachers, parents, and researchers, and of inquiry and exploration as a process of knowledge construction (Ponte, 2001). The program is being jointly designed by a multinational consortium of educators, representatives of parents' and teachers' organizations, experienced distance learning instructors, authors of technology supported courses, and technicians, in order to ensure consideration of all different perspectives into the integrated pedagogical framework. Particular care is being taken to build on parents' knowledge and experiences and to respect cultural differences in parenting approaches (Onikama et al., 1998).

The course participants will be provided with ample opportunities for interactive and collaborative learning through use of contemporary technologies. The strategies employed include open-ended investigations, use of real-data, simulations, visualizations, collaboration and reflection on one's own and on others' ideas and experiences. Through use of these strategies, we will offer a learning environment that will serve as a model to the participating parent educators as to the type of training they should provide to parents.

### PROJECT ACTIVITIES

In the two-year timeframe of the program, the following activities will take place:

**Development of a pedagogical framework for parent training in mathematics and science:** At the outset of the project, the consortium worked towards developing a framework for best practices in parent training programs in mathematics and science education, through combined use of eLearning and physical meetings. The preliminary design of the framework, which is guiding the design of the parent-trainer training course, has been based on desk research into the different approaches to parent education used across Europe and internationally, and after taking into account cultural differences in teaching and learning methods, as well technical considerations regarding online course delivery (e.g. current limitations in terms of equipment, software, proto-

cols, and network bandwidth). The pedagogical framework will be validated during the pilot delivery of the parent-trainer course and the follow-up parent training workshop, and revised accordingly.

**Development of parent-trainer training course and accompanying parent training pack:** The consortium has begun designing the parent-trainer training course pack and the accompanying parent-training pack, based on the guidelines set in the pedagogical framework. The parent-trainer training course pack will provide a state-of-the-art overview of new pedagogical methodologies and didactical routes in parent education. It will aim at equipping parent educators with the most up-to-date knowledge, skills, and technologies to successfully implement high-quality parent training in mathematics and science education. Special emphasis will be paid to EU transversal policy issues, such as promoting participation of females, integration of disabled people, and inclusion of socially and economically excluded families.

The parent-training pack will offer technology-enhanced, research-based and culturally adapted educational aids and resources to support children's development in mathematics and science at home, to be adapted and used by parent educators in their parent training programs. It will consist of multimedia based training modules, to be delivered as a series of mini-workshops, that will familiarize parents with some general principles of learning, with learning theories specific to mathematics and science, with school curricula, as well as with the use of learning technologies (e.g. use of state-of-the-art mathematics and science educational software as well as general-purpose software like Excel, guidelines for selecting appropriate educational software and for making internet surfing safe and conducive to learning, etc.).

Material is being developed in the partners' national languages (English, Greek, Czech, and Spanish) and will be culturally differentiated to accommodate local conditions in each participating country. The content will be in digital form and will be available online via the project dedicated knowledge base (see below). It will also be available in CD/DVD format to overcome potential bandwidth limitations.

**Design and development of knowledge base infrastructure and service:** In parallel to the development of the instructional material, the team has started working on the technical design and development of an online knowledge base to support the project activities and outputs. The knowledge base, implemented as an interactive multilingual web portal, will support anytime, anywhere education and collaboration of parent educators and parents around Europe. It will include the parent-trainer and parent training packs developed through the project and a variety of other distance learning tools and resources for parent educators and parents, including forums for discussion and networking between parent educators and parents.

**Pilot testing and validation of the parent-trainer course and accompanying parent training pack:** Before being offered to the European education community, the parent-trainer training course and its accompanying parent training pack will be pilot tested locally in three of the partner countries, on groups of 15-20 parent educators per country. Upon completion of the parent-trainer training course, some of the course participants will run parent training workshops in their respective communities, using the

parent training pack developed by the consortium. Various forms of assessment tools and protocols will be used to collect and document evidence of changes in parent educators' pedagogical and content knowledge of mathematics and science, attitudes towards the subjects and teaching practices, and the impact that these changes might have on their ability to provide effective parent training. The analysis of these data will inform the revision of the pedagogical framework and the instructional materials and services, before finalizing the course and offering it via Grundtvig.

**Offering of Grundtvig parent-trainer training course:** The revised parent-training course will enter the EU Lifelong Learning Training Database for increasing visibility and access to parent educators across Europe). It will be offered as a Grundtvig training course targeting school and/or adult mathematics and science teachers, school administrators, counselors, representatives of parent associations, or other professionals involved in training activities for parents. Course participants will explore a broad range of topics of interest to the mathematics and science parent educator. They will also be introduced to the parent training pack developed by the consortium, and to the pedagogical framework underlying its development.

Parent educators will receive training through combined use of e-learning and physical classroom meetings. The course will be made up of three parts:

- (i) *ICT-mediated preparation using the project knowledge base:* The first part of the course will be delivered online utilizing the interactive knowledge base built specifically for this project. The knowledge base will contain all the content of the parent-trainer training course, as well as the parent training pack and other resources (e.g. research papers, useful links, etc.). It will also offer tools for professional dialogue and support (e.g. discussion forums, chat rooms, etc). While there will not be specific 'classroom hours,' parent educators will work according to a loose schedule set by the consortium. Each week will typically involve a range of activities, readings and contributions to discussion, as well as completion of group and/or individual assignments. Online moderated discussions— both asynchronous and synchronous - will allow participants to share content, ideas, and instructional strategies.
- (ii) *One-week Intensive training seminar:* Course participants from all over Europe will gather together to attend the seminar (they can finance their expenses by applying for a grant under the Lifelong Learning/Grundtvig-program). The seminar will consist of a combination of mini-workshops that will include technology-based and hands-on activities in small groups (5-6 persons), presentations by experts, role-play, videos documenting learning activities of parents with children, and discussions. During the seminar, there will be particular emphasis on enhancing parent educators' skills in adapting the provided parent training material based on the context-specific needs and interests of parents in their community. Language of tuition will be English.
- (iii) *Guided field practice:* At a final stage, parent educators will undertake a teaching experiment. They will customize and expand upon the parent-training materials provided to them, and apply them in their own communities.

Partners will act as mentors, providing their support to parent educators using online communication tools. Once the guided field practice is completed, parent educators will report on their experiences to the other parent educators, and exchange ideas and insights as to how to further improve their parent training practices.

Delivery of the course will be facilitated by members of the consortium from all participating countries with expertise in mathematics and/or science education. Since the course will be designed to be a community-based learning experience, the role of the research team will be to guide the discussions and encourage full, thoughtful involvement of all participants, and to provide feedback.

Upon successful completion of the course, participants will get certification as authorized trainers to run the parent training program developed through this project.

**Knowledge base Content and Services Enrichment:** At the end of the project, final revisions and enhancements to the knowledge base content and services will be made and it will then be opened to all interested parents and parent educators. The knowledge base will integrate a variety of resources and distance learning and communication tools. It will include: (i) A *"hypertextbook"* with the content of the *parent-trainer training course*, to be used as a self-paced course, in a facilitated online mode, or as part or all of the material used in a face-to-face course or workshop; (ii) The accompanying *parent training pack*, which could be used by distance-learning organizations delivering training to groups of parents and/or other adult end-users, or for independent study by individual parents; (iii) *Collaboration tools* supporting dialogue and exchange of ideas between European parents and parent educators, such as forums of discussion, chat rooms, and application sharing; (iv) *Mathematics and Science Family Kits* that will include culturally and developmentally appropriate educational games and technology-enhanced and hands-on activities parents can do at home with their children to strengthen their learning; (v) *Reports and articles* developed through the project; (vi) *Links to mathematics and science education resources* available on the Internet. The open access to the project outcomes and the information published through the knowledge base by users outside the consortium will ensure sustainability of the system after the completion of the project.

## CONCLUDING REMARKS

SMASH is an innovative program, developed in response to the need for reaching out to parents and informing them about new developments in mathematics and science education. Taking into account best practices in mathematics and science education, adult education, and distance learning, the project aims to enrich European children's learning of mathematics and science by cultivating underlying home cultures as springboards for learning.

The parent-trainer training course to be developed through the project goes far beyond traditional adult training practices. It will build parent educators' knowledge and skills through a hands-on, inquiry-based approach that seamlessly combines best pedagogical practices with contemporary technologies, including the Internet for maximum flexibility. The course will equip professionals attending the course with the

most up-to-date knowledge, techniques, and implementation tools for the provision of high-quality training in mathematics and science education to parents of elementary and middle school children in their communities.

Another innovation of the program is that no other European-level program with combined focus on the pedagogical aspects of science and mathematics has the direct involvement of parents that this project will pursue. Unlike SMASH, most parent outreach efforts tend to occur at the local or national level and to present mathematics and science in disconnected ways that do not help parents see the connections between mathematics ("the language of science") and science.

Mathematics and science literacy are among the key competencies that all individuals need in a knowledge-based society for employment, inclusion, subsequent learning, as well as personal fulfillment and development. These competencies should be acquired by the end of compulsory schooling, since they are a prerequisite for participation in lifelong learning. By focusing on improving student achievement in mathematics and science at a young age through fostering children's learning at home, the project will widen access to mathematics and science competences among European youth, providing them with essential knowledge tools and the foundations for lifelong learning skills.

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