

## **UTILIZING DISTANCE EDUCATION TO OFFER WEB-BASED PROFESSIONAL DEVELOPMENT IN STATISTICS EDUCATION TO TEACHERS ACROSS EUROPE**

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*The paper provides an overview of a new program recently funded by the European Union that aims to enhance the teaching and learning of early statistical reasoning in European schools by utilizing distance education to offer high-quality professional development experiences to geographically-dispersed teachers across Europe. Acknowledging the fact that teachers are at the heart of any educational reform, the project will facilitate intercultural collaboration of European teachers using contemporary technological and educational tools and exemplary web-based materials and resources. Long-term sustainability will be assured through support of multilingual interfaces and online services for the accumulation of collective knowledge from teachers and teacher educators. An online knowledge base will offer access to usable and validated pedagogical models, didactic approaches, and innovative instructional materials, resulting in a complete and flexible teacher professional development program.*

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

The Lisbon European Council of March 2000 placed the development of a knowledge-based society at the top of the Union's policy agenda, considering it to be the key to the long-term competitiveness and personal aspirations of its citizens. Statistics education has a crucial role to play in this regard. In a world where the ability to analyze, interpret and communicate information from data are skills needed for daily life and effective citizenship, statistical concepts are occupying an increasingly important role in mathematics curricula. Statistics education is becoming the focus of reformers in mathematics education as a vital aspect of the education of citizens in democratic societies (National Council of Teachers of Mathematics [NCTM], 2000).

A common thread emerging from mathematics educational research is the direct relationship between improving the quality of teaching and improving student learning (Stigler and Hiebert, 1999). As teachers play an important role in innovation (Frykholm, 1999) it is critical for them to have rich teaching and learning experiences to adapt faster to change. Statistics may be as new a topic for teachers as for children (Lajoie and Romberg, 1998). Many of the older teachers have never formally studied statistics. Younger teachers may have taken an introductory course at college; such a course however typically does not adequately prepare future teachers to teach statistics. College-level statistics courses are often lecture-based courses that do not allow future teachers to experience the model of data-driven, activity-based, and discovery-oriented statistics they will eventually be expected to adopt in their teaching practices.

Technological advances, and especially web-based training, make it possible to overcome restrictions of shrinking resources and geographical locations and to offer high quality online professional development in statistics education to teachers across Europe in a cost-effective and non-disruptive way. The web offers the potential for teachers in different countries to collaborate and build communities of practice in social constructivist learning environments. Collaborative and participatory communities of teachers have been shown to act as vehicles that promote teacher learning and development (Tinker and Haavind, Concord Consortium, 1997).

### **PROJECT OBJECTIVES**

The overall aim of the program, which began in October 2005 and will run for three years, is to enhance the quality of statistics education offered in European elementary and middle schools by facilitating intercultural professional development of teachers using exemplary web-based educational tools and resources. Acknowledging the fact that teachers are at the heart of any educational reform effort, the consortium, composed of five partner institutions (Cyprus College, Sor-Trondelag University College, University of Thessaly, Aristotle University of Thessaloniki, Cadiz University) in four European countries, will utilize distance education to

offer high-quality professional development experiences to geographically-dispersed teachers across Europe. More specifically, the project has the following objectives:

a) *Developing and pilot testing a professional development course in statistics education for elementary and middle school mathematics teachers.* The design of the course will be based on current pedagogical methodologies utilizing collaboration, statistical investigation, and exploration with online interactive problem-solving activities.

b) *Conducting a teaching intervention* into the statistics classrooms of the teachers attending the pilot professional development course. The materials and resources developed will be evaluated and revised through this real-classroom implementation.

c) *Designing and developing a multilingual knowledge base for statistics education* that will offer a variety of online resources and tools for pre-service and in-service teachers, as well as teacher trainers. The knowledge base development will be an iterative process incorporating teacher input in its design and services to offer the most appropriate opportunities for networking and support. The site will target long-term sustainability through services that support the online accumulation of end-user collective knowledge on best practices, technological developments, pedagogical methods, implementation in specific settings, etc.

d) *Initializing networking among teachers across Europe* by building an online community of the teachers participating in the pilot delivery of the professional development course for the exchange of ideas, content, tools, and instructional practices relating to statistics education. The long-term objective will be to sustain and to expand this community into a pan-European virtual network of communication for pre- and in-service teachers of statistics.

e) *Developing a pedagogical framework* that would provide recommendations on how to take advantage of available web-based technologies for the effective delivery of high-quality online professional development in statistics.

#### PEDAGOGICAL AND DIDACTICAL APPROACH

Distance education is a useful framework for in-service teacher training, but it can represent a large variety of pedagogical perspectives. The most common approach is to follow a highly structured format, setting objectives and sub-objectives in detail and designing tasks to fit these objectives. Recognizing the fact that professional development is most effective when deeply contextualized in the teacher's professional activity (Smylie, 1995) and that teachers will bring a diverse variety of strategies into the program as a result of their own professional experiences, the project adopts a different approach, which respects and utilizes teachers' professional knowledge. The distance education environment will be designed as a framework for flexible learning (Collis and Moonen, 2001), regarding teachers as the main agents of their professional development, supported by an environment rich in challenges and interactions. The design will be based on the importance of collaboration and reflection, and of inquiry and exploration as a process of knowledge construction (Ponte, 2001). Rather than using the text-based static content that tends to be the norm in distance education of mathematics/science courses, teachers will be provided with ample opportunities for interactive and collaborative learning through the use of contemporary multimedia and internet technologies. The strategies employed will include open-ended investigations, simulations, visualizations, collaboration and reflection on one's own and on others' ideas and experiences. Through use of these strategies, the project will provide a learning environment that will serve as a model to the participants.

#### PROJECT ACTIVITIES

In the three-year timeframe of the program, the following activities are/will take place:

*Development of instructional content for professional development course:* During the first two years, the project team will design and develop, using contemporary technological and web-based resources, curricular and instructional materials on statistics for elementary and middle school teachers and students to be used during the professional development course. Central to the development of the material will be the functional integration of technology with existing core curricular ideas: specifically, the integration of new types of tools (e.g., the dynamic statistics software *Fathom* and *Tinkerplots*) which provide students with the opportunity to model and investigate real world problems of statistics. The course material will be produced in all partners'

national languages (Greek, Norwegian, Spanish), as well as in English.

*Design and development of knowledge base infrastructure and service:* In parallel to the development of the instructional material, the team will work on the technical design and implementation of the infrastructure and services for the dedicated knowledge base that will support the project activities and outputs. In addition to a hypertextbook with the training material to be used during the professional development course, the knowledge base will also contain other support material (e.g., papers on educational theory and practice). Furthermore, it will support multilingual interfaces (EN, EL, NO, ES) to overcome linguistic barriers, and will offer tools for professional dialogue (e.g., discussion forums, chat rooms, application sharing etc.).

*Pilot delivery of online professional development training on statistics education and follow-up classroom experiment:* During the final year of the project, the online professional development course will be pilot tested with a group of 10-12 teachers from the four partner countries (2-3 teachers from each partner country), and revised based on feedback received from pilot testing. The instructional content and services on the dedicated knowledge base will be utilized for teaching, support and coordination purposes. The course will be delivered through text, illustrations, animations, audio/video, technology-rich interactive problem-solving activities, and multilingual interfaces. The course material will also be available in CD/DVD format to overcome potential bandwidth limitations. To offer teachers flexibility, and to accommodate different time zones, the largest portion of the course will be delivered asynchronously. However, there will also be some synchronous delivery through use of technologies such as digital blackboards, audio/video streaming, and videoconferencing. While there will not be specific 'classroom hours,' teachers 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 assignments. Some weeks will also require teachers to create something, e.g., a *PowerPoint* presentation, which will be posted on the knowledge base. Online moderated discussions will allow teachers to share content, ideas, and instructional strategies. The course will be facilitated by members of the research team with expertise in statistics education.

The course, which will be designed to last for thirteen weeks, will be made up of three parts. During the first four weeks, the emphasis will be on enriching the participants' knowledge of statistics content by exposing them to similar kinds of learning situations, technologies, and curricula to those they should employ in their own classrooms. Teachers will then spend the next four weeks focusing on children's learning and what is required to involve them in learning about statistics. They will explore a broad range of topics of interest to the statistics teacher (e.g., computer-supported teaching, the role of statistics in the national and European mathematics curricula, common student misconceptions, etc.) At the final stage of the professional development course (weeks 9-11), teachers will undertake a teaching experiment. They will customize and expand upon provided materials, and apply them in their own classrooms with the support of the design team. Once the teaching experiment is completed, they will report on their experiences to the other teachers in their group, and will also provide samples of their students' work for group reflection and evaluation (weeks 12-13). Teachers will exchange insights as to how to further improve their practices and increase their students' achievement.

*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 teachers and teacher educators. The knowledge base will include the following: (i) *A hypertextbook* with the material, resources, and activities of the professional development 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) *Technologically enhanced curricular and instructional materials* for the teaching and learning of statistics in elementary and middle school; (iii) *A digital Video Case Library* containing segments of real teaching episodes, obtained in the classrooms of the teachers participating in the project, representing the landscape of practice in statistics instruction throughout Europe, for use by pre-service and in-service teachers and by teacher educators; (iv) *A database containing Student Work Samples* developed through contributions of the participating teachers, providing examples of good practice in European schools that could also be used in teacher preparation and professional development programs; (v) *Reports and articles* developed through the project; (vi) *Links to statistics*

*education resources* available on the Internet; (vii) *Collaboration tools for teachers and trainers* including email, conferencing, chat rooms, and discussion forums. 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.

*Development of pedagogical frameworks for online professional development in statistics:* The pedagogical and technical experts in the project team will work jointly to develop a framework for the effective delivery of online professional development to teachers of statistics. This framework, which will be developed at the beginning of the project to guide the design of the professional development course and will be revised based on knowledge gained through the pilot delivery, will provide expert and practitioner recommendations; it will incorporate both pedagogical and technical considerations regarding delivery of online professional development (e.g., limitations in terms of equipment, software, protocols, and network bandwidth).

## CONCLUDING REMARKS

This project, which aims to improve elementary and middle school mathematics teachers' pedagogical and content knowledge of statistics by offering online professional development, is the first of its kind in Europe. Taking into account best practices in statistics education and distance learning, it will promote interactive learning and cross-cultural exchange of experiences and ideas. The project knowledge base will offer access to usable and validated pedagogical models, didactic approaches, and innovative materials for the teaching and learning of statistics, resulting in a complete and flexible professional development program that will be of direct use not only to the teachers participating in the program, but also for independent study by teachers across Europe and beyond. It will provide a minimum cost service for teachers, ensuring wide use of the system. Maximum dissemination and long-term sustainability will be achieved through support of multilingual text interfaces and online services for the accumulation of collective knowledge from end users. The project outputs and services will be useful not only to teachers, but also to academic experts in statistics education, to national and European Education boards, to teacher training institutions, and to designers of online professional development programs. The ultimate beneficiaries will be students, who will eventually benefit from improved curricula and teaching practices that will help them build their statistical reasoning.

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