

## DISTANCE LEARNING FOR TEACHER PROFESSIONAL DEVELOPMENT IN STATISTICS EDUCATION

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*The paper provides an overview of EarlyStatistics, an online professional development course in statistics education targeting European elementary and middle school teachers. The course utilizes distance education to offer high-quality professional development experiences to teachers across Europe. It facilitates intercultural collaboration of teachers using contemporary technological and educational tools and resources. An online information base offers access to all of the course content and resources, resulting in a complete and flexible teacher professional development program.*

### INTRODUCTION

The direct relationship between improving the quality of teaching and improving students' learning is a common thread emerging from educational research (Stigler & Hiebert, 1999). For it is what a teacher knows and can do that influences how she or he organizes and conducts lessons, and it is the nature of these lessons that ultimately determines what students learn and how they learn it. Thus, to achieve fundamental changes to the instructional methods and tools employed in the mathematics classroom to teach statistical and probabilistic concepts, it is critical for teachers to have rich teaching and learning experiences in statistics and its pedagogy.

In recent years, it has been recognized that for teacher training to become more effective in producing real changes in classroom practices, it ought to promote continuous, professional development opportunities that are cumulative and sustained over the career of a teacher (Joubert & Surtherland, 2009). The financial and logistic difficulties of engaging teachers in face-to-face professional development opportunities, as well as the need for professional development which can fit with teachers' busy schedules and can draw on powerful resources often not available locally, have encouraged the creation of online teacher professional development programs (Dede et al., 2006). Numerous initiatives in online teacher professional development are underway.

In this article, we provide a brief description of the main experiences gained from implementing *EarlyStatistics*, a 3-year project (2005-2008) funded by the European Union, which exploited the affordances offered by open and distance learning technologies to provide teachers of statistics across Europe with access to a wide array of colleagues, discussions, and resources eluding them in their workplace. A consortium of five higher education institutions from four countries (Cyprus, Greece, Spain, Norway), developed and pilot tested an intercultural online professional development course in statistics education targeting European elementary and middle school teachers. The course aims at helping teachers improve their pedagogical and content knowledge of statistics through exposure to innovative web-based educational tools and resources, and cross-cultural exchange of experiences and ideas.

### EARLYSTATISTICS PILOT COURSE CONTENT AND STRUCTURE

A pilot delivery of *EarlyStatistics* took place during the final year of the project in three of the partner countries (Cyprus, Greece, Spain). Fourteen teachers participated in the pilot delivery. The pilot course lasted 13 weeks, and was made up of six Modules. In Modules 1-3 (Weeks 1-6), the focus was on enriching the participants' statistical content and pedagogical knowledge by exposing them to similar kinds of learning situations, technologies, and curricula to those they should employ in their own classrooms. The conceptual "Framework for Teaching Statistics within the K-12 Mathematics Curriculum" (Franklin et al., 2007) was used to structure the presentation of content. Statistics was presented as an investigative process that involves four components: (i) clarifying the problem at hand and formulating questions that can be answered with data; (ii) designing and employing a plan to collect appropriate data; (iii) selecting appropriate graphical or numerical methods to analyze the data, and (iv) interpreting the results.

Through their participation in authentic educational activities such as projects, experiments, computer explorations with real and simulated data, group work and discussions, participating teachers learned where the “big ideas” of statistics apply and how, and developed a variety of methodologies and resources for their effective instruction.

In Modules 4-6, the focus shifted to classroom implementation issues. Participating teachers developed and delivered teaching episodes integrating the use of the course tools and resources provided to them. They customized and expanded upon provided materials (Module 4; Weeks 7-9), and applied them in their own classrooms with the support of the design team (Module 5; Weeks 10-11). Once the teaching experiment was completed, they reported on their experiences to the other teachers in their group, and also provided video-taped teaching episodes and samples of their students’ work for group reflection and evaluation (Module 6; Weeks 12-13).

Each module involved a range of activities, readings and contributions to discussion, as well as completion of group and/or individual assignments. Online moderated discussions allowed teachers to share content, ideas, and instructional strategies. Teachers were provided a space to discuss and grapple with the complexities of teaching and learning, foster alternative perspectives and apply educational theory to practice (Kayler & Weller, 2007).

After completion of the pilot testing, the *EarlyStatistics* course was revised based on feedback received from the course pilot delivery and the follow-up classroom implementation. It then entered the European Union Lifelong Learning-Comenius database for European wide recruitment. It will be offered to the European educational community as a Comenius in-service course targeting mathematics teachers. The *EarlyStatistics* course has been scheduled for offering three times during 2010, in two of the partner countries (Cyprus and Greece). The consortium intends to continue offering the course in subsequent years, thus increasing access to large numbers of teachers involved in statistics education.

#### MEDIA AND TECHNOLOGY CHOICES

The *EarlyStatistics* pilot course was delivered using a “blended- learning” method. There were a few face-to-face meetings with local teachers, but the biggest part of the course was delivered online, through text, illustrations, animations, audio/video, technology-rich interactive and problem-solving activities. The instructional content and services of the project dedicated information base were utilized for teaching, support and coordination purposes. To offer teachers flexibility and to accommodate different time zones, but also to provide time for reflection and considered response, the largest portion of the course was delivered asynchronously through discussion and mail groups. There was also some synchronous communication through use of technologies such as audio/video streaming, and videoconferencing.

The course was developed and delivered by using Moodle, an easy to use, open source course management system designed to help educators in creating quality online courses. While Moodle is freeware, it has a user-friendly and reliable interface, and offers a lot of excellent applications that can be used to support the learning process. For example, the system offers a variety of distance collaboration tools (e.g. discussion forums, wikis, chat rooms, application sharing, etc.) which were utilized in *EarlyStatistics* to allow interaction among peers and course facilitators. Moreover, to support learners not fluent in English, the course used multilingual interfaces (Greek, Spanish, English).

Central to the course design was the functional integration of technology with existing core curricular ideas, and specifically, the integration of statistics educational software (the dynamic software Tinkerplots<sup>®</sup> and Fathom<sup>®</sup>), as well as a variety of activities and resources available online (e.g., simulations, animations, video clips, etc.), which stimulate and engage teachers and provide them with the opportunity to investigate real world problems of statistics.

#### LESSONS LEARNED

The overall feedback from the target user groups from all partner countries participating in the *EarlyStatistics* course pilot delivery, as well as from external experts regarding the course content, services, and didactical approaches was generally very positive. Key conclusions from the analysis of the user feedback were that *EarlyStatistics* was quite successful in helping teachers to improve their pedagogical and content knowledge of statistics. Also, data obtained from the teaching experimentations in the course participants’ classrooms suggest that their teaching

interventions led to gains in student learning outcomes and attitudes towards statistics.

Despite the overall success of the pilot course, a number of shortcomings have also been identified. The biggest difficulty experienced by the consortium was in achieving the successful building of an online community of teaching practitioners, which was a main objective of the project. From the outset of the project, we were well aware of the challenges in developing such a community, of the fact that merely forming a discussion group and providing the technology does not automatically lead to the establishment of relations and group cohesion (Gordon et al., 2007). The experience from the pilot testing of *EarlyStatistics* further alerted us to the fact that community building, particularly in a cross-national context, is quite challenging. The course participants' overburdened schedules and the diversity in their cultural and professional backgrounds made the establishment of a functional online community of practice quite challenging. Although we tried our best to encourage online dialogue and collaboration and to ensure that all teachers actively contribute to discussion forums, sometimes we achieved, other times however we failed. Often, what happened was that only 3-4 teachers would actively participate in the discussion forums, while the rest would hardly make any contributions. Gould and Peck (2005), in their first offering of INSPIRE, a distance education professional development course targeting new secondary school statistics teachers in the US which also had community-building as one of its main objectives, experienced similar disappointment with a much lower than anticipated level of student-to-student interaction.

A reason that might have contributed to our limited success in building an online community of practice is the fact that during the pilot delivery, there was no face-to-face meeting with all course participants. There were a few face-to-face meetings with local teachers, but not with the group as a whole. Course participants got the chance to virtually meet teachers from the other countries through video-conferencing, this however cannot be as effective as face-to-face interaction. As a result, teachers built strong local groups, but had more limited interaction with teachers from other countries. In future course offerings, participants will be recruited from around Europe, and at the course start there will be a face-to-face meeting with all participants. Teachers will get familiarized with the course and its objectives, and with the facilities offered by the e-learning environment. More importantly, they will get the chance to meet and interact with one another. We believe that this initial in-person meeting will reinforce teacher online engagement by mitigating the problem of trust and social presence online.

Finally, the limited experience of the course facilitators in distance learning was also a drawback of the course. The team members that facilitated *EarlyStatistics* are very experienced statistics educators who have been involved for several years in teacher training. Nonetheless, this was the first time they were offering professional development online. Consortium partners with extensive previous expertise in distance education acted as mentors and provided hands-on training on a number of topics relating to e-learning. This undoubtedly helped course facilitators to improve their instructional skills in distance education. However, they still faced some difficulties in leading the discussion forums. While in guiding discussions, the *EarlyStatistics* course facilitators tried to encourage full, thoughtful involvement of all participants, and to provide constructive feedback, they did not always manage to achieve productive interaction and critical reflection of the participants. Undoubtedly, however, the valuable experiences they gained from this pilot delivery will allow them to employ much more effective moderating strategies in future offerings of the course.

## CONCLUSIONS

In order to make statistical thinking accessible by all students, there ought to be fundamental changes to the instructional methods and tools employed in the mathematics classroom to teach statistical and probabilistic concepts. The need for the training in statistics education of large numbers of teachers makes distance learning an attractive option. Internet technologies make it possible to overcome restrictions of shrinking resources and geographical locations and to offer, in a cost-effective and non-disruptive way, high quality learning experiences to geographically dispersed statistics teachers.

Despite the potential benefits of implementing an online teacher training course in statistics education, there are a number of possible risks that could adversely affect its quality. Teachers participating in such a course are likely to be characterized by diversity in a number of

different parameters (educational level and grade they teach, mathematics curricula, cultural and/or professional backgrounds, comfort with technology and with distance learning, etc.). The experiences gained from implementing the *EarlyStatistics* program, alert us to the fact that while online teacher professional development shares many features with face-to-face programs, it also presents some unique challenges. Several pedagogical, but also technical issues have to be incorporated into the course design in order to provide an effective online learning environment that motivates and supports teachers.

A particularly important issue for a model of online teacher professional development is how to ensure the successful building of an online community of practice. As the pilot testing of the *EarlyStatistics* teacher professional development course indicates, online community building is quite challenging. Although the course team employed several strategies to promote teacher dialogue and collaboration, they were not completely successful in establishing a functional online community. As Gould and Peck (2005) note, leading a discussion of substance on a “discussion board” than in a real classroom is quite challenging. Merely forming a discussion group and providing the technology does not automatically lead to the establishment of relations and group cohesion. Garfield and Everson (2009), whose at-distance teacher training course has been quite successful in achieving learner participation and collaboration, explain that their online courses go through a continuous cycle of evaluation and improvement. Each time an online course is taught, changes are made in the way in which discussion assignments are structured and used, based on feedback received from students and on careful study of the patterns of interaction occurring within different discussion groups

Teaching online courses is a new, unexplored territory for most statistics instructors. Online instruction is similar yet different from face-to-face learning, requiring new or different teaching skills and strategies. Online instructors’ new role as course facilitators turns them into both guides and learners (Heuer & King, 2004). They must be trained in this new mode of instruction, to facilitate student success and develop online participation, as they develop in the art of becoming effective online guides.

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