

## Teacher Professional Development in Statistics: New Venues Through Distance Learning

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### ABSTRACT

*EarlyStatistics, a 3-year program funded by the European Union, aims to enhance the teaching and learning of statistics in European schools by harnessing the power of the Internet to provide European teachers with access to a wide array of colleagues, discussions, and resources eluding them in their workplace. The project consortium has developed and is currently pilot testing a high-quality online professional development course in statistics education targeting elementary and middle school mathematics teachers around Europe. The course facilitates intercultural collaboration of teachers using contemporary technological and educational tools and resources.*

**KEYWORDS:** *Statistics, Professional development, Distance education*

### INTRODUCTION

In a world where the ability to analyze, interpret and communicate information from data are skills needed for daily life and effective citizenship, developing a statistically literate society has become a key factor in achieving the objective of an educated citizenry. 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). Recognizing teachers' ongoing professional development and learning as a linchpin of instructional innovation and success for their students (Ginsberg, 2003), the EU-funded project *EarlyStatistics* exploits the affordances offered by ODL technologies to help improve the quality of statistics instruction offered in European schools. The project consortium has developed and is currently pilot testing an online professional development course targeting European elementary and middle school mathematics teachers. The course, which is the first of its kind in Europe, aims at helping teachers improve their pedagogical and content knowledge of statistics through exposure to innovative learning methodologies and resources, and cross-cultural exchange of experiences and ideas.

The project has a 3-year duration (October 2005-September 2008). The project team spent the first two years of the project towards designing and developing a line of research-based curricular and instructional materials to be used during the professional development course. In parallel to the development of the instructional material, the team worked on the technical design and implementation of the

infrastructure and services for a dedicated knowledge base that supports the project activities and outputs.

A pilot delivery of the professional development course is currently underway. The course will then be revised based on feedback received from the pilot delivery, and will enter the Lifelong Learning-Comenius Training Database for EU-wide participation. Final revisions and enhancements will also be made to the knowledge base content and services, and it will then be opened to all interested teachers and teacher educators.

In this article, we describe the pedagogical and didactical approach underlying *EarlyStatistics*, and the pilot course content and structure. At the conference, we will also be able to present a synopsis of the main findings from the course pilot delivery.

### **PEDAGOGICAL AND DIDACTICAL APPROACH**

*EarlyStatistics* has adopted “learning” and “community” rather than “instructional” models of professional development (Barab & Duffy, 2000). Contemporary visions of web-based instruction and computer-mediated communication which support more collaborative and participatory models of education underpin the course design.

Acknowledging the fact that teachers bring a diverse variety of strategies into the course as a result of their own professional experiences, *EarlyStatistics* adopted an approach that respects and utilizes teachers’ professional knowledge. The distance education environment has been designed as a framework for flexible learning (Collis & Moonen, 2001), regarding teachers as the main agents of their professional development, supported by an environment rich in challenges and interactions.

A central conviction underlying *EarlyStatistics* is that learning is a social act best supported through collaborative activities (Vygotsky, 1978), and thus learning as part of a community of practice can provide a useful model for teacher professional development. The *EarlyStatistics* course promotes intercultural awareness and exchange of experiences and ideas among European teachers. Teachers interact and learn about statistics by engaging in joint activities and discussions, helping each other, and sharing best pedagogical strategies. Through these interactions, they build relationships and construct a community that supports best practices and innovation in statistics instruction. This online community of practice, which supports the sharing of multiple, multinational perspectives, shapes both teachers’ identity as practitioners and the identity of the practice itself (Gray, 2004).

*EarlyStatistics* participants are provided with ample opportunities for interactive and collaborative learning through use of a wide array of tools, artefacts and resources (Gordon et al., 2007). They are actively involved in constructing their own knowledge, through their participation in authentic educational activities such as projects, experiments, computer explorations with real and simulated data, group work and discussions. Central to the course design is the functional integra-

tion of technology with existing core curricular ideas, and specifically, the integration of new types of tools (the dynamic statistics software Tinkerplots<sup>©</sup> and Fathom<sup>©</sup>), which provide teachers, and subsequently their students, with the opportunity to model and investigate real world problems of statistics. We hope that this inquiry-based, learner-centred approach, will serve as a model to the participating teachers as to the kind of learning situations, technologies and curricula they should employ in their own classrooms.

### **EARLYSTATISTICS PILOT COURSE CONTENT AND STRUCTURE**

The *EarlyStatistics* course, in its pilot version, lasts 13 weeks, and is made up of six Modules. In Modules 1-3 (Weeks 1-7), the focus is on enriching the participants' statistical content and pedagogical knowledge. To help teachers go beyond procedural memorization and acquire a well-organized body of knowledge, the course emphasizes and revisits a set of central statistical ideas. The conceptual "Framework for Teaching Statistics within the K-12 Mathematics Curriculum", developed by a group of leading statistics and mathematics educators (GAISE, 2005), has been used to structure the presentation of content. This framework uses a spiral approach so that instructional programs from pre-kindergarten through high school encourage students to gradually develop understanding of statistics as an investigative process with four components: (i) formulating questions, (ii) collecting data, (iii) analyzing data, and (iv) interpreting the analysis and relating the interpretation to the original question. The spiral organization of content aims at helping teachers understand statistics as a comprehensive approach to data analysis. Using real data, active learning and technology, participating teachers learn where the "big ideas" of statistics apply and how, and develop a variety of methodologies and resources for their effective instruction.

In Modules 4-6, the focus shifts to classroom implementation issues. Teachers customize and expand upon provided materials (Module 4; Weeks 8-9), and apply them in their own classrooms with the support of the design team (Module 5; Weeks 10-11). They write up their experiences, including a critical analysis of their work and that resulting from their pupils. Once the teaching experiment is completed, they report on their experiences to the other teachers in their group, and also provide video-taped teaching episodes and samples of their students' work for group reflection and evaluation (Module 5; Weeks 12-13).

The course is delivered through a blended learning approach. There are a few face-to-face meetings with local teachers, but the biggest part of the course is delivered online, by utilizing the project information base for teaching, support and coordination purposes. To offer teachers flexibility and to accommodate different time zones, the largest portion of the course is conducted asynchronously through discussion and mail groups. There is also some synchronous communication through use of technologies such as audio/video streaming, and videoconferencing.

Teachers work according to a loose schedule. Each module involves a range of activities, readings and contributions to discussion, as well as completion of group

and/or individual assignments. Online moderated discussions allow the course participants to share ideas, and instructional strategies. Teachers are provided a space to discuss and grapple with the complexities of teaching statistics, foster alternative perspectives and apply educational theory to practice (Kayler & Weller, 2007).

## CONCLUSIONS

The direct relationship between improving the quality of teaching and improving students' learning is a common thread emerging from educational research (Stigler and Hiebert 1999). Recognizing the central role of teachers in educational reform, *Early Statistics*, aims to enhance the quality of statistics education offered in European schools through developing, pilot testing, and offering a high-quality intercultural online professional development course in statistics education targeting elementary and middle school teachers across Europe. The course is based on current pedagogical methodologies utilizing collaboration, statistical investigation, and exploration with online interactive problem-solving activities. Particular care has been taken to build on participating teachers' knowledge and experiences, and to promote collaborative and participatory learning (Barab & Duffy, 2000). Teachers from different countries have the opportunity to improve their content and pedagogical knowledge of statistics through open-ended investigations, simulations, visualizations, collaboration and reflection on one's own and on others' ideas and experience. Use of these strategies will, hopefully, motivate teachers to successfully complete the course, but, more importantly, to make the difficult leap from professional development activities to classroom practice.

## REFERENCES

- Barab, S. A., & Duffy, T. (2000). From Practice Fields to Communities of Practice. In D. Jonassen, & S. M. Land (Eds.), *Theoretical Foundations of Learning Environments* (pp. 25-55). Mahwah, NJ: Lawrence Erlbaum Associates.
- Collis, B., & Moonen, J. (2001). *Flexible Learning in a Digital World: Experiences and Expectations*. London: Kogan Page.
- GAISE College Report (2005). *Guidelines for assessment and instruction in statistics education*. The American Statistical Association [Online]. Available: <http://www.amstat.org/education/gaise> (Accessed February 2008).
- Ginsberg, M. B. (2003). *Motivation Matters: A Workbook for School Change*. San Francisco: Jossey-Bass.
- Gray, B. (2004). Informal learning in an online community of practice. *Journal of Distance Education*, 19(1), 20-35.
- Kayler, M., & Weller, K. (2007). Pedagogy, Self-Assessment, and Online Discussion Groups. *Educational Technology & Society*, 10(1), 136-147.
- National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.
- Stigler, M., & Hiebert, J. (1999). *The Teaching Gap*. New York: Free Press.
- Vygotsky, L.S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University.