# PORTFOLIOS AND PERFORMANCE ASSESSMENT: TOOLS FOR CHANGING PEDAGOGY WITH PRE-SERVICE MATHEMATICS TEACHERS

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Portfolios serve many roles in the development of prospective teachers. Faculty at Brooklyn College found that portfolios can play two other important roles — as tools in faculty development and as a conduit in the development and description of college curriculum. Faculty came together to design a portfolio outline which both defined the introductory mathematics methods course and facilitated establishment of standards. The format was adapted for other populations, each time being modified to suit the new context.

Teacher preparation programs are paying increased attention to the role of portfolios in their curriculum, as many schools are exploring use of portfolios with children, and some states are requiring teaching portfolios for certification. Meyer and Tusin distinguish between the prospective teachers' perceptions of portfolios as "process" or "product" [1]. Corresponding to this distinction, two primary roles that portfolios play in teacher preparation are to further the teachers' personal growth [2,3] and to evaluate the teachers [4]. These two roles are not independent, as indicated in the Assessment Standards for School Mathematics proposed by National Council of Teachers of Mathematics (NCTM) [5] which include as one of the six standards the "Learning Standard;" namely, that "Assessment should enhance mathematics learning." It is also appropriate for prospective teachers to experience development of their own portfolios as a model for how children might engage in the same process [6].

Faculty at Brooklyn College have found that portfolios can play two other important roles — as conduits for increased faculty communication, and as a means of describing the key themes and expectations of a course or program.

## The Introductory Mathematics Methods Course for Elementary School Teachers

Each semester at Brooklyn College, over two hundred students are enrolled in about eight education courses concerning methods of teaching elementary school mathematics.



The Journal of Mathematics and Science: Collaborative Explorations Volume 3 No 1 (2000) 75-81

These students are drawn from three different populations: undergraduate daytime prospective teachers; undergraduate students who are taking the same courses at night, often because they work as paraprofessionals; and, post-baccalaureate but pre-graduate elementary teachers. Over the years, a number of innovations have been introduced that have benefitted both students and professors in all of these courses, including: (1) diagnostic pre-tests; (2) the use of hands-on activities and manipulatives which enhance students' understanding of basic concepts and offer a base from which to build understanding of others' knowledge in mathematics; (3) the modeling of multiple types of assessment. A number of faculty had tried some form of portfolio assessment, but these portfolios often lacked clear definition, and the result was that at the end of the semester, the Mathematics Education faculty could barely be seen behind stacks of bulging looseleafs, boxs, and bags. Burn-out was imminent.

The large number of courses, taught by at least eight different full- and part-time faculty members, has raised issues: how to define course content and ensure coverage of this basic content for this diverse population; how to promote a conversation among the richly varied teaching staff (full-time faculty, and school personnel with varied backgrounds); and, how to model new forms of assessment in a practical way. With the formation of the New York Collaborative for Excellence in Teacher Preparation (NYCETP) came the opportunity to tackle the third issue of assessment, which also served to address the first two issues.

A committee of full-time and adjunct faculty met over several semesters to develop and test a portfolio requirement which would be suitable as part of the assessment for a range of courses. Portfolios also gave the faculty the opportunity to focus not only on the traditional elements of teacher preparation, such as planning and reflective practice, but also on new areas, such as standards, mathematical thinking, writing, and furthering one's own mathematical learning. The work of the Portfolio Committee was grounded in the realities of urban schools and fueled by the contexts of various school reform efforts in New York City through the input of adjunct faculty, most of whom are school practititioners and work daily as staff developers, district coordinators, and school leaders in mathematics.

After a number of semesters of designing and implementing various pieces of the portfolio, the team was satisfied with six sections as being representative of what all of

the introductory K-6 mathematics methods courses should highlight. Colored cover sheets were duplicated for every student in these programs. Each page had a brief rationale for inclusion of the section, followed by guidelines and some examples of what might be included. Students were asked to include material satisfying the guidelines which represented their best work and to explain why they submitted these items. The full page is included for section six below. Others have similar elaborations.

**Section 1: Design of Mathematics Material and Planning for Its Use**

**Section 2: Selection and Use of Commercial Mathematics Material**

**Section 3: Assessment of Individual Children's Mathematical Thinking**

**Section 4: Integration of Mathematics with Other Curriculum Areas**

**Section 5: Reflection on Teaching Practice**

**Section 6: Lesson Planning – Teaching Mathematics to Small Groups**

Careful planning is essential if a teacher is to maximize children's learning in the relatively short time available to devote to mathematical ideas.

This semester, you have been writing lesson plans according to a format which asks you to write extensively about key elements of a lesson. In the next pages, include a lesson plan which you have executed, together with your critique of the lesson, and samples of student work.

Below, discuss why you chose this lesson to include in your portfolio. Also, discuss whether (and how) it could be adapted for other instructional settings — for example, whole class vs. small group, a different grade level, or a different mathematical skill.

Throughout the semester, class activities, field assignments, and other work culminated in discussions about selecting work to include in portfolios. These discussions invariably included a focus on standards, demonstrating emerging *knowledge* of mathematics pedagogy and deepening understanding of mathematics. The final result

became a manageable and focused selection of student work. As portfolios were completed over successive semesters, exemplary student work was collected to be shown to later classes. When students see models of superior work, the overall level of portfolio entries is raised.

As a result of use of this portfolio model over three semesters, faculty began giving a more uniform range of assignments, and also grading patterns became more uniform among different sections of the same course. Students could see the commonality of courses throughout the program, rather than reflecting individual characteristics of professors. Students reported that their preparation of a mathematics education portfolio was very helpful as an exhibit in job interviews.

## Adaptations for Other Contexts

The work on portfolios at Brooklyn College went well beyond the initial preparation of elementary teachers. Professors in both middle and secondary mathematics education began to use the same approach with graduate program and in-service courses. In each new context, the model was modified and enriched. Portfolios became a way of defining program objectives and standards.

*A. **Elementary Masters program:*** Teachers enrolled in a masters program, with a specialty in teaching mathematics in grades K to 9, take a sequence of four Education courses as a cohort. Currently, the cohort numbers nearly 50 per year. These teachers are already provisionally certified, and should all have had a course such as the one described above for which the portfolio was designed. For the sequence of four courses, the faculty agreed that each semester the students should be able to add materials relevant to that course to a section in each of four broad categories: Looking at Curriculum, Looking at Children, Looking at Policy, and Looking at Connections. In each course, all assignments could be included in one of these sections. For example, in the first course in this sequence, written assignments were given throughout the course, from which one or two examples could be selected or modified and submitted. Examples for each category were: analysis of how texts or other curriculum materials match the New York State Curriculum Standards; case studies of children's understanding of particular concepts; description of and rationale for exemplary practice in early childhood mathematics; and, identifying mathematics potential in science museums and designing a "Treasure Hunt" for students to use there, as they develop or apply mathematics topics or

processes that they are learning in school. The portfolios assembled by the teachers in the first course were passed on to the professors in the next course, as a way to introduce the teachers to their professors through their work. Portfolios used in this way promoted better articulation among the courses in the sequence. They also made it easy for faculty to consult with each other about grading practices.

***B. Secondary undergraduate methods course.*** The faculty for the student teaching seminar in secondary mathematics began with the same general portfolio outline, but used this framework to have students develop a holistic rubric which was used to evaluate the class portfolios, using a 1-6 scale for each section. This work on developing rubrics fit in smoothly with consideration of the new performance standard recently adopted by New York City's Board of Education.

***C. Mathematics courses in Masters program.*** Portfolios had played a role for several years in a geometry course for teachers of grades K to 9. This course exposed many teachers for the first time to the possibilities for visual creativity in geometry. When left undefined, the portfolio became a large collection of two and three dimensional constructions. A more focused portfolio was initiated in another course for the same population, Number Systems and Algebra. This portfolio had only three categories and for each, students were to select one item. They were given three cover pages to describe and organize their work. The three categories were: Exemplary Solution to a Problem, in which students were to concentrate on the generic NCTM Standards of Problem-Solving and Communication; Review of a Resource Material (intended to be non-textbook, and approved by the instructor); and, Evidence of Independent Study. The latter two categories were included in recognition of the fact that, in the current climate of reform of school mathematics, teachers are being required to learn and apply mathematics topics that are new to them. Teachers must become life-long learners, and cannot rely on all the mathematical information they need coming to them through coursework. They must learn of the many resources available through which they can learn — books, journals, web sites — and they must develop a critical approach to these resources, recognizing quality in mathematical thinking. Student portfolios which fit this structure have been useful tools in communicating to new mathematics faculty the special nature of these courses and how they promote the professional development of teachers of grades K to 9. A similar portfolio structure is being developed for the remaining four mathematics courses in this program.

***D. In-service courses.*** Faculty who had been part of the development of the initial portfolio took the same model to in-service courses, but adapted it to suit the population. For example, in a funded, in-service program for secondary teachers, all of whom are teaching a quite similar curriculum, an important component of the portfolio became the inclusion of evidence of student work. In another funded program, Mathematics Education faculty team taught with faculty from Geology and Mathematics departments. Portfolio entries had an interdisciplinary flavor in this setting. The Mathematics professor subsequently began asking students to submit portfolios of their work in a mathematics course for undergraduate prospective elementary teachers.

The use of portfolios in the mathematics education strand is now being examined by faculty in other content areas. What began as a technique for defining a particular course is becoming a technique for defining a teacher preparation program. The development of this portfolio model could not have taken place without the input of a dedicated faculty, some of whom contribute to the work at Brooklyn College in addition to their heavy responsibilities in the Board of Education. We would like to thank Josephine Urso, Trudy Adducci, Joseph Porzio, Debbie Montagna, Terry Gurl, as well as our full-time faculty, David Fuys, Livia Denis, Brenda Strassfeld and Barbara Freeouf. ■

## Bio

Rosamond Welchman is a professor in the School of Education at Brooklyn College of the City University of New York. After earning a Ph.D. in Mathematics, she began her teaching career in mathematics departments. She had the opportunity at Brooklyn College to begin teaching a combined mathematics, methods, and field-based course, and soon became a member of the faculty of the School of Education. She has been Program Head of the Early Childhood Division, both Acting Assistant Dean and Acting Dean of the School of Education, and is currently Program Advisor for secondary mathematics teachers. Her publications include: a mathematics/methods text for elementary teachers co-authored with David Fuys; a monograph reporting on research into the Van Hiele model of thinking of adolescents, co-authored with Dorothy Geddes and David Fuys; and, five other books for teachers with an emphasis on uses of interesting contexts and manipulatives that promote problem solving and reasoning. She has been involved in a number of funded projects for staff development in local schools, and has also been invited to teach as a visiting faculty member in Oregon, California, Texas, and Mississippi. She frequently gives workshops and other presentations for local teachers.

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