

Mathematics Teaching Practice Assessment using Student-Teacher Portfolios

Luckson Muganyizi Kaino

Department of Mathematics Education, University of South Africa, South Africa
Email: kainolm@unisa.ac.za

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Abstract

The mathematics student-teacher portfolio is used to document information about mathematics teaching, student-teacher progress through stages of experimentation and achievements during the teacher preparation period. Generally, portfolios have been considered to be reflective tools where student- teachers reflect on why, what and how they teach to meet set objectives. This theoretical paper provides a background on the use of a portfolio in student-teacher teaching practice and its significance in teacher preparation by referring to the mathematics subject. The portfolio assessment procedures are outlined and the portfolio assessment instruments developed and discussed. At the end, the portfolio assessment manual is presented. The author recommends the use of a portfolio in assessing mathematics student-teachers to form a greater part of teaching practice assessment.

Keywords: Student-teacher portfolio, Teaching practice, Mathematics teaching, , Assessment

1. Introduction

The student-teacher portfolio is a process document for the student-teacher development that records progressive levels of achievement in teacher preparation. The portfolio is not a one-time event for assessment but a comprehensive document that records progressive levels of achievement and sets the stage for specific goals. The portfolio applies reflective teaching approaches to professional training and development for student-teacher growth through critical enquiry, analysis, and self-directed evaluation, and has sometimes been distinguished from behavioral skills or craft apprenticeship approaches which, in contrast, emphasized the acquisition of pre-determined classroom practice (Zeichner, 1983; May & Zimpher, 1985). The student teaching portfolios is described as a tool for promoting reflective practice as it provided the opportunity for the prepared teacher to think about what one does and why (Borko, et al 1997) and thus assess past actions, current situations, and intended outcomes, the practice that is reflective rather than routine aiming at helping the teacher candidates to think reflectively on their decisions and experiences (Richert, 1990). The portfolio has been defined as a systematic and organized collection of evidence used to monitor growth of the student's knowledge, skills, and attitudes in a specific subject area (Blake et al., 1995 & Takona, 2003) and also as a purposeful, collaborative, self-reflective collection of student-teacher work generated during the process of instruction (DeBruin-Parecki, et al., 1997). Reflection can influence how the student-teacher grows as a professional by learning from his/her own experiences. Reflective practice has been described to involve one's own experiences in applying knowledge to practice while being coached by professionals in the discipline (Schon, 1996) and introduce the requisite knowledge and skills to approach teaching in a reflective way (Borko, et al., 1997). Research on effective teaching showed that effective practice was linked to inquiry, reflection, and continuous professional growth (Harris, 1998). The latter view seems to hold for over the past two decades now as evidenced from various literature on teacher education. Reflective practice has been found beneficial to professional development at both the pre-service and in-service levels of teaching where student-teachers could improve their effectiveness in the classroom (Ferraro, 2000).

Generally, teaching portfolios have received increasing attention as tools to promote reflection among both experienced and novice teachers and the support for portfolios as reflective tools is strong (Wolf, Whinery & Hagerty, 1995). Proponents of portfolio use claim portfolios provide an opportunity and a structure for teachers to document and describe their teaching; articulate their professional knowledge; and reflect on what, how, and why they teach (e.g., Loughran & Corrigan, 1995; Wolf et al., 1995; Zubizarreta, 1994). Despite some evidences that teacher portfolios were tested tools for assessment many years ago as shown in studies such as those by Athanases (1994) and Wolf et al. (1995), portfolios have seldom been studied as a vehicle for teacher learning and growth. The few published empirical studies of portfolios consistently argue that portfolios appear to foster teacher reflection. At the pre-service level, for example, investigations helped student-teachers to remember classroom events more fully and accurately, and focused

their reflections on content and contents of specific aspects of their teaching (Richert, 1990). They also created a need for student teachers to systematically examine their practice; encouraged them to gather information on their practice, their students, and their schools; and created a meaningful context in which to link the university and its research-based knowledge with the classroom and its practical demands (Lichtenstein, Rubin, & Grant, 1992). A study by Loughran and Corrigan (1995) found portfolios to be useful either for encouraging reflection on practice or for helping student teachers in job interviews. Observations indicate developing portfolios during teaching practice enhanced student teachers' interest in teaching practice as it provided the opportunity for student- teachers to reflect on their teaching (Saiqa & Hafiz, 2006).

The portfolio assessment of teaching practice, first introduced at the University of Botswana in 2010, sought to investigate the impact of the innovative new professional development/assessment system on the professional growth and development of in-service teachers in Botswana. The findings of the study suggested that although student-teachers found portfolio development to be cumbersome and time-consuming, the general consensus was that developing portfolios provided useful and valuable learning experience which enhanced their creativity, reflective practice and continuous professional growth (Sithole, 2010). Overall, students found portfolio development and its assessment and evaluation of a cumulative collection of their creative works to be a better approach for the assessment of teaching than the traditional approach. The study also found out that there was a lack of consistency in the way supervisors assessed students' portfolios and for this reason, it concluded with the recommendation that in order to increase the reliability and credibility of portfolio assessment, there was a need to provide intensive orientation and clear guidelines to students and all f supervisors in the form of clear expectations for the purpose of selection of artifacts, organization, reflection, assessment and evaluation of portfolios (Sithole, 2010 *ibid.*). The findings from the latter study are important towards the adaption of the use of the student- teacher portfolio in assessing teaching practice in the college.

2. Information that Should be Contained in a Mathematics Student-Teacher Portfolio

The mathematics portfolio records the information on student-teacher improvement and development using the following:

- Establishing and documenting a baseline of information about mathematics teaching
- Progressing through stages of experimentation and change.
- Engaging in collaboration.
- Realizing enhancement of particular areas through rigorous assessment.
- Recording actual improvement and positing further goals.

The student-teacher portfolio should be an evidence based narrative document in which the student organizes details of his/her teaching accomplishments and uses this information of documentation to reflect on teaching experiences for improvement of teaching and student learning. The portfolio supplies the teacher with a vehicle for gathering evidence of learning and for definite action to improve the impact of teaching on a specific student group.

2.1 Content of the mathematics student-teacher portfolio

During the teacher training/preparation period, each mathematics student-teacher should generate a portfolio that contains the following information:

- Student-teacher's name: student ID, Year, Subject/Programme
- School name, address, telephone, email, etc
- Name of school supervisor and contacts
- Name of Headmistress/Headmaster and contacts
- Name of class teacher and contacts
- Table of contents: this will indicate what is in the portfolio
- Information sheet about the class (Bio-data of students): names of students, gender, performance in mathematics, etc
- Mathematics syllabus
- Mathematics Teaching Philosophy statement

The statement may contain the following information:

- i) what the student-teacher believes is good in mathematics teaching
- ii) explanation of what he/she hoped to achieve in mathematics teaching
- iii) description of his/her mathematical teaching strategies and techniques
- iv) mathematics teaching effectiveness and ability of the student-teacher to reflect on his/her teaching and

learning

- Records of scheming and mathematics lesson planning
- Records of mathematics lesson notes, assignments, problem-solving activities, tests and other mathematical activities
- Records of evaluation of mathematics lessons by both student teachers and supervisors
- Records of resource materials used: prescribed mathematics textbooks, reference books, calculators, computers, etc.

3. Summary of What a Teaching Portfolio Should Contain

As the portfolio is organized in a dynamic assessment task, not simply a static end product, it comprises two important aspects, one is the *process* the other is the *product*. The process involves learning from the variety of experiences offered in the pre-service education program and encouraging student teachers to reflect on these. The *product* is the development of the individual portfolio items that are used to demonstrate this learning to others (Loughran & Corrigan, 1995). The *process* contains:

- Reflection: the student-teacher should be able to reflect on the mathematics topics intended to teach during the teaching practice period as indicated in his/her scheme of work. These topics must have been taught to the student-teacher at pre-service training with micro teaching exercises
- Narrative: the student-teacher should present a comprehensive and clear mathematical lesson plans and notes reflected from the scheme of work
- Analysis: the material in the portfolio should reflect the candidate's ability to analyze the mathematical concepts and examples taught in class, organization and classroom control
- Goals: the goals to be achieved during the teaching practice should be clearly stated and implemented. These should include both the mathematical content and pedagogical knowledge of the student-teacher professional development
- Revisions: the portfolio should indicate revision of mathematical activities by the student-teacher during the teaching practice period. These revisions should indicate the student-teacher ability to reflect on the material taught in class. Also students' mathematical revision exercises should be documented in the portfolio
- Mentoring: the portfolio should reflect the mentorship the student-teacher is going through during the teaching practice exercise as assisted by the school supervisors and visiting mathematics college lecturers
- Improvement: the portfolio should indicate that the student-teacher is gaining knowledge and experience than before the teaching practice exercise commenced

The *product* contains evidence of all the above and should be demonstrated by assessing/evaluating the student-teacher's portfolio and the implementation through the classroom.

4. Assessment Procedures

First, the teacher and the student need to clearly identify the portfolio contents, which are samples of student work, reflections, teacher observations, and conference records. Second, the teacher should develop evaluation procedures for keeping track of the portfolio contents and for grading the portfolio. Third, the teacher needs a plan for holding portfolio sessions, which are formal and informal meetings in which students review their work and discuss their progress. These sessions encourage reflective teaching and learning and are essential part of the portfolio assessment process (Venn, 2000). According to Paulson, Paulson and Meyer, (1991, p. 63): "Portfolios offer a way of assessing student learning that is different than traditional methods. Portfolio assessment provides the teacher and students an opportunity to observe students in a broader context: taking risks, developing creative solutions, and learning to make judgments about their own performances". Diane Hart defines a portfolio as "a container that holds evidence of an individual's skills, ideas, interests, and accomplishments." The ultimate aim in the use of portfolios is to develop independent, self-directed learners. Long-term portfolios provide a more accurate picture of students' specific achievements and progress and the areas of needed attention (Hart, 1994).

The student-teacher assessment is cumulative and based on multi formative and summative assessment contributing to a single overall grade.

(i) Formative assessment

The student-teacher's formative assessment involves;

- The use of the portfolio information by both the school supervisors/mentors and the lecturers
- Maintaining a currently updated portfolio ready to produce when requested by the supervisors. This includes a continued reflection and revision on the personal teaching philosophy
- Systematic self-assessments comprising of post lesson evaluations and reports on student-teacher's progress by school mentors/supervisors

(ii) Summative Assessment

The student-teacher summative assessment involves;

- Pre and post meeting sessions between the supervisor and student-teacher. These sessions should be used as reflection sessions for planned lesson and taught lesson respectively
- An accumulate mark that would be used with the formative mark generated to develop a final grade

5. Portfolio Assessment Manual

Score	0	1	2
Item	Nothing provided/no evidence/no resources, etc	Incomplete	Complete/evidence adequate/well articulated, etc
Student-teacher particulars/information			
Table of contents			
Professional knowledge			
-philosophy of teaching mathematics			
-submitted mathematics lesson plans and written tasks			
Reflection on mathematics teaching & learning			
Mathematics teaching & learning process			
-schemes of work			
-lesson plans developed from schemes provided			
-resources used-handouts, charts, etc			
-self evaluation of lessons conducted			
-feedback from mentors/supervisors			
-samples of students' work			
Assessing and evaluating students' mathematics work			
-assessment plan (for a particular topic)			
-an example of assessment given and an example of feedback given to students			
-an example of progressive feedback given to students showing how this was followed through			
-an example of an assessment record sheet			
Management and Organizational skills			
-description of how a class was organized to carry out a particular mathematical activity and a reflective evaluation of the effectiveness of management skills			
-a record of how the student-teacher dealt with one or two specific discipline problems			
-excerpts from supervisor's reports regarding management and organizational skills			
-description and samples of various forms of mathematics teaching/learning aids used in instruction with a reflective evaluation of each resource			
Other professional qualities and developmental plans			
-evidence of involvement in school mathematics extracurricular activities			
-final reflections on growth and development throughout the course			
Reflections by student-teacher			
Peer assessment of student-teacher's experience during TP based on reflections and portfolio documents			
Interview by mathematics lecturers and department/ministry of education of suitability for another TP or recommendation for employment			

The above manual guide shows that the portfolio construction can be a complex activity that involved set rules and standards (Darling, 2001). The manual should be guided by the nature of the tasks set and the kind of contexts in which student-teachers are prepared (Calderhead, 1989). The assessment manual is flexible and the assessment levels can be set to achieve intended objectives.

6. Concluding Remarks

The importance of using a mathematics portfolio in assessing student-teachers has been articulated and the guide can be formed into a generic manual that can be applied to other subjects. The emphasis is made that portfolios gear to reflective practice in teacher preparation and that in order to promote reflective teaching, a clear conceptual grasp is required of what the processes of reflection in the portfolio involve and what students would usefully reflect about. The student-teacher reflection is influenced by the nature of the mathematical tasks set in the portfolio. The portfolio assessment manual construction is a complex social practice with intentions, rules and standards set to minimize the usual hassles caused by observation of student-teachers during the teaching practices supervision period. The portfolio should not be a one-time event assessment but a comprehensive document that records progressive levels of achievement set to achieve specific goals during the student-teacher preparation period. The student-teacher portfolios should promote students to be reflective mathematics teachers who should link better the theory and classroom practice during all the period of preparation for quality production of teachers.

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