

## **Digital Reflective Portfolio use in the Training of Future Mathematics Teachers as a Contribute to Formative Assessment and Deepening Didactic Knowledge for Teaching Practices in Students' Classrooms**

**Ana Henriques**

Assistant Teacher

Institute of Education at the University of Lisbon

Portugal.

e-mail: [achenriques@ie.ulisboa.pt](mailto:achenriques@ie.ulisboa.pt)

<https://orcid.org/0000-0001-7844-2157>

### **Abstract**

*The digital reflective portfolio is a prominent resource in innovative teaching practices in education, for convenient report of the students skills and their achievements of the learning process to obtain them. As teachers are not familiar with use of portfolio in mathematics school context, is essential to use it in the training of mathematics prospective teachers (PTs). The formative assessment with portfolio aims to providing methodological support their work in the classroom. This paper present the results of a qualitative and interpretative study focus on training experience of mathematics PTs from the 3rd cycle of basic and secondary education, whose aims is to understand the contribution of using the digital reflective portfolio in mathematics PTs training for their formative assessment and the mathematical and didactic knowledge to possible use in future practices. This study contribute to identifying the potential of their portfolio used for necessary encouragement and learning to professional development in future teaching practices.*

**Keywords:** Use of Digital reflective portfolio; mathematical and didactic knowledge; Initial training of mathematics prospective teachers; Formative assessment; Teaching practices in students classrooms.

### **1. Introduction**

Mathematics is a fundamental curricular discipline for students' school learning. Current curriculum documents suggest the use of formative assessment and digital portfolio as an effective resource in teaching that favors to develop students' self-regulated mathematics (ME, 2018), which is an international curricular component fundamental to dealing with life contexts of human culture (NCTM, 2014; Lygianne & Geraldo, 2020). That results from having an opportunity to carry out activities and reflect on what they created in that activity and what to remake based on feedback system (Santo & Pinto, 2010). However, the use of mathematics portfolios in students formative assessment and learning in school context is not usual yet, as teachers also are not fully familiarized with this resource to carry out teaching practices. Thus, considering these challenges, it is essential to highlight to adopt the digital reflective portfolio as a goal for an adequate formative assessment in initial teacher education, with a

view to promoting their mathematical knowledge and the use of the portfolio, to support students' learning in their future teaching practices (Santos, 2020).

As studies on the benefits of using portfolios in the initial training experience for the learning of mathematics prospective teachers are not common, is pertinent this reported study developed in an initial training experience of Portuguese mathematics prospective teachers of the 3rd cycle and secondary education. Whose Aims is to understand the contribution of the adopted use of reflective digital portfolio based on given feedback, in the 3rd cycle of basic and secondary mathematics prospective teachers formative education, for the necessary encouragement and development of their mathematical and didactic knowledge to promote their use in future professional practice. Thus, this study may contribute to the scientific and educational community, of several educators of this area, to identify the recommended and recognized considerations on the potential of innovative and specific integration of the digital reflective portfolio in the initial training of mathematics prospective teachers, as useful for their necessary encouragement and support for professional development, when they become familiar with this approach, to improve and privilege real situations of educational contexts.

## **2. Theoretical Context**

### **2.1. Digital reflective portfolio in initial training**

As the initial training experience is a starting point for professional teaching practice, is recognized as relevant for support prospective teachers (PTs) to be able to learn and understand various mathematical themes in current essential mathematics learning and how to integrate assignments and portfolio in their future student learning classes (Dempsey & O'Shea, 2020). Regarding the elaboration and evaluation of the portfolio, and to respond to the challenges and demands of mathematics education, some contents, presentations and organization are suggested to be carried out by the PTs in individual work (Lurdes & al, 2005) some aspects that can be appreciated by the educator taking into account the adequacy, scope and correction to be considered in their formative evaluation criteria (Delandshere & Arens, 2003): (i) The PTs selection of a variety of tasks to be included in the portfolio, which should constitute a representative set of work carried out on the topics studied throughout the training, taking into account what is considered their best works carried out as a contribution to his learning; (ii) In each selected task, the PT should must present what it was asked to do in her, its resolution, a reflection justifying the reasons for its choice for inclusion in the portfolio, the procedures adopted for a good performance or overcoming difficulties, and finally the reformulations carried out to improve some version of work after feedback; (iii) One final digital reflection about the work carried out in the portfolio, focusing on the developed skills to undertaking tasks and in formative assessment, and the learning provided in his training as a future Mathematics teacher, and its possible use in future professional student practices. To renewing the teaching-learning process the portfolios should be carried out in digital format, and the evaluators and colleagues can give feedback and exploring noticing-oriented activities including examples of students' work on the tasks, under is construction, to develop their ability to enriching the final production, as a process connected to a progressive understanding of their related mathematical and pedagogical elements (Pereira & al., 2015).

### **2.2. Formative Assessment**

The formative assessment should also be a component indispensable in the PTs training, guided by feedback, as a process continuous and determined, to developing actions that help their motivation and responsibility in the achieving learning, and to improve their learning or overcoming some difficulties, performing tasks to activate analysis of thought and curricular content (Raymond & al. 2005). Thus, the given feedback enable them to be successful in the summative assessment and as professional competent.

### 3. Methodology

This qualitative and interpretative study (Bogdan & Biklen, 1994), was carried out in an initial training experience for 3rd cycle and secondary Portuguese prospective teachers, involved 11 male and female prospective teachers participants of the first year of a master degree of the mathematics teaching, aiming to understand the contribution of the adopted use of reflective digital portfolio based on given feedback, for the necessary encouragement and development of their mathematical and didactic knowledge to promote their future professional practice.

Data were collected and analyzed, at the end of the training classes, regarding their individual carried work included in the digital reflective portfolio, through the selection of the variety of worked tasks on the topics studied in the training (Mathematical reasoning, Statistical reasoning and investigation; Computational Thinking; STEM), taking into account: their resolution and reflection justifying its choice based on what they considered the best works carried out as a contribution to his learning; the reformulations carried out to improve some version of work after feedback; the final global reflection, in view of that it provided for training as a future mathematics teacher and formative assessment, and its possible use in future professional practices of students.

### 4. Results

To assess de PTs perceptions of using Mathematical learning tasks topics developed in the portfolio, and reflection about the contribution of this resource and possible use in students teaching practices, the analyzed elements of the portfolio records prepared by all PTs relating to the work carried out in the training session, where the obtained responses of the participants sought to know how developed their work on the tasks, reflections and video, that they included in the elaboration of the portfolio, and what domains they recognized as the potential of portfolio to promote Mathematical knowledge and satisfaction in the development of this instrument to use in future practices.

For example, the PTs made an appropriate selection of several mathematical tasks included in the portfolio whose thematics were worked during the training, presented in Table 1.

**Table 1.** Research data of tasks solved by Pts in the portfolio.

Pts (number)	Tasks selected	Thematics (curricular objectives)
3,10,11	numbers, numbers, Diagonal rectangles	Mathematical reasoning in Algebra, Geometry
7,9	Quadratic functions	
1, 2, 4, 5, 8	Pyramids and prisms	
1,2,5,6,8,10	The human body	Statistical Reasoning and investigation
1,3,4,6,7,8,9,10,11	Robot Paths	Computational Thinking

These tasks were collected individually by the PTs, but some resolutions in groups in the classroom with collective discussion, being well aware and carefully selected. After choosing each task, they solved it and justified their decisions through descriptive reflections on the portfolio carried out, and received feedback from the trainer through questions and suggestions to complement or enhance aspects of tasks and video including in portfolio. They complemented well the structured portfolio according to the suggested guidance, that allow a good final summative assessment, as they presented evidences of constructed knowledge improvements on studied topics and strategies used to learn.

They also recognized and justified the relevant potentialities of these solved tasks chosen, as allow to reach their knowledge of the characteristics in these curricular objectives, which most depend on to promote their future teaching and students learning. For example, they highlight:

“I highlight the importance of the materials made available as a means to clearly develop the stages of mathematical reasoning and statistical investigation, which prove to be useful the application of these tasks in mathematical learning in the classroom. The opportunity to make a digital portfolio, to know how it works, I consider to be an important source to keep students more motivated from traditional teaching, who like technological tools, and currently be an important source of formative assessment” (PT1). “In my view, after choice and resolution, these tasks effectively fulfill the learning objectives, and I will manage very well to fulfill the function of promoting the development of mathematical capacity of students which is extremely important to they adopt mathematical and statistical reasoning skills. From activities carried out and the elaboration of the portfolio, I acquired a will and knowledge for the integration of technology in the classroom, to help students explore and learn new things in their learning, for having better understood how I can do it” (PT2).

“I believe this work, of chose and worked important tasks, and the role of teacher’s feedback, was important for promote our knowledge in training, I better understood these mathematics processes and how to promote them to students, given that technological portfolio are increasingly present in PTs and students Teaching” (PT3).

“The skills I developed by performing the tasks in this portfolio and their feedback were creativity and innovation, contributed to my understand and learning how to prepare tasks and asking guiding questions to introduce in future classes, in order to help students to reach their learning. The construction of the portfolio was the culmination of all the work carried out, I hope to be able to put into practice the skills acquired and developed with this construction, through this instrument, students can present evidence of built knowledge of the strategies used to learn” (PT4).

“My choice and solving of tasks focused on topics on which I felt a greater evolution in my mathematical learning and a reflection on their importance to the students' knowledge. Another potentiality of this work developed through the digital portfolio, that I had never heard of before, I believe it also contributed significantly to my new knowledge and quite interesting to work in my future as a teacher the mathematical efficiently and to promote the use of technological tools with my students, valuing their mathematical knowledge and the development of various skills and abilities” (PT5).

“I carried out this work on the portfolio with great pleasure, centered on the selection and elaboration of some tasks, as it contributed in a positive way to improve and deepen my knowledge as a PT on these topics that I was not familiar with. Task resolutions and student exploration of developed skills that I acquired in the portfolio, gave confidence for something new working more efficiently with students on these topics in the future of mathematics teaching” (PT6).

“The tasks chosen and carried out in this portfolio supported skills that I hadn't known about, and the difficulties were overcome with feedback which is really fantastic. I considered necessary to hope me to apply in the future classroom for encourage my students to carry out their work and to use digital platforms in the classroom to promote mathematical abilities” (PT7)

“The criteria that guided my choice and resolution of tasks was great use for me, as I have opportunity to recover my understanding of the various subjects of mathematics, due to its centrality presented in the curriculum for the teaching of mathematics. And could benefit more my future teaching practice, based on the opportunity to reflect the pertinence of these tasks to developing the knowledge and skills that I intend to pass on to students. Learning how to build the proposed digital portfolio, having never used it, proved to be important for PTs to the creativity of working and understanding the potential of this resource because students can have an overview of the work done by them according to the feedback from the teacher and colleagues that can contribute to learning” (PT8).

“The tasks carried out, selected for the construction of portfolio, helped me a lot to evolve as a PT. Considering that having focused on the various contents worked, which I was not yet related, I acquired knowledge about learning mathematics and construction of the digital portfolio in the classroom, and it became clearer how I can work with students the privileged thematic contents in the current curricular documents to promote various capacities and how students can have an overview of the work done by them according to the feedback from the teacher and colleagues that can contribute to learning” (PT9).

“ The themes chosen seemed important to develop some skills that I think important at the teaching level of the 3rd cycle. It was productive to solve tasks that allowed me to deepen the depth of the themes and difficulties that students may have, I feel more prepared to the teaching and learning processes in the classroom, and more sensitized to the importance of tasks as they are presented to students which will be useful to support them more easily. It's the first time I use this portfolio tool both to share docs and make videos and it's very useful for collaborative work. Regarding this tool, my learning was total and fruitful” (PT10)

In addition to the content that most calls my attention, the students' resolutions and the teacher's questions analysis where essential learning being operationalized. This tasks work implemented in learning scenario, based on problems with real contexts, allowed me, observing the mathematical content in a meaningful way to the students. My learning was the understanding of the potential and how to, building a digital portfolio and supporting feedback that can contribute to student learning” (PT11).

## **5. Conclusion**

Concisely, the results show that prospective teachers value positively the use of digital reflective portfolio for solving the tasks, mentioning advantages of using and presenting evidence of constructed knowledge of the work used to learn. The training methodology implemented within the scope of the curricular unit privileged situations in the educational context in which each future teacher developed his/her pedagogical intervention, which served as a starting point for reflective processes of a personal, academic and professional nature. There are many references that express their recognition of the impact of portfolio use in their learning processes in mathematics, highlighting how this experience helped them to understand mathematical concepts they have previously learned. They also recognized a positive impact of

The data analysis of the prepared portfolios allows describing the advantages of using this training strategy both from the trainer point of view and from the perspective of future teachers, highlighting the countless and diverse possibilities for professional development, namely with regard to the construction of didactic knowledge in the context of Mathematics Education. In the final video reflection, they reported their understanding of the importance of the selected tasks, the potential of the tasks they solve during the training and chose to portfolio, as how they use the feedback, and the adopted tasks that contributed to promote their knowledge, also what recognized and how they would propose portfolio to the students' potential they have identified.

In this context we assumed as relevant to carry out a teaching experiment with pre-service mathematics teachers who were attending the use of portfolio, aiming to promote their continuity learning, with understanding and development of correct meanings of the mathematical concepts, that allow to describe how this understanding is evidenced and to assist them in developing it in order to enhance the required mathematical knowledge for teaching.

To this end, the portfolio should include at least situations of learning mathematics tasks, and themes, in which tasks explored in the group training sessions were carried out. It is also highlighted that the indications regarding the elaboration of the portfolios are transmitted to the prospective teachers, in

particular right at the beginning of the training and the trainers should inquire about their development and make themselves available to give feedback on texts and videos that the trainees are building.

In this initial teacher training, the preparation of the portfolio was a way of including prospective teachers in the analysis of the contents of the work they carried out, as well as fostering the understanding of what effectively constitutes good work, a work aimed mainly at teachers who are still inexperienced, for assessment and professional development purposes. The fact that future teachers build a portfolio and, in addition, carry out some specific exercises, proposed by each assessment model, has shown to have positive effects on their educational practices and on their self-perception of their teaching skills. Using the portfolio as part of a multidimensional information collection system (including multiple tasks, feedback and regular support from the evaluator) increases the accuracy and comprehensiveness, as well as the reliability of the assessment.

Finally, the Poster will also discuss the results of the study in the light of the mathematical Learning Environment that was created and, in particular, of the specific characteristics of the software.

## References

- Bogdan, R. & Biklen, S. (1994). *Investigação qualitativa em educação*. Porto Editora.
- Delandshere, Ginette; Arens, Sheila A. (2003). Examining the quality of the evidence in preservice teacher portfolios. *Journal of Teacher Education*, 54(1), 57-73.
- Dempsey, M., & O'Shea, A. (2020). The role of task classification and design in curriculum making for preservice teachers of mathematics. *The Curriculum Journal*, 31(3), 436-453. <https://doi.org/10.1002/curj.18>
- Lygianne Batista Vieira & Geraldo Eustáquio Moreira (2020). Contribuições da Educação Matemática para a cultura de respeito à dignidade humana. *Bauru*, 8 (2),173-188.
- Lurdes, S., Canavarro, A.P., Guerreiro A., Isabel R. and José P. (2005). *O PROGRAMA DE FORMAÇÃO CONTÍNUA EM MATEMÁTICA: CONTRIBUTOS DA INVESTIGAÇÃO*, XXII SIEM, 2011.
- Ministério da Educação (2018). *Aprendizagens Essenciais Matemática*. Lisboa: DGE.
- NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS (2014). *Principles to actions: Ensuring mathematical success for all*. Reston, VA,.
- Pereira, E.G. et al. (2015). Portfolio in education in health: contribution to reflection from its use at the discipline nursing in communicable diseases. *ABCS Health Sciences*, 40(3), p. 329-332.
- Raymond, L. Pecheone, Matthew J. Pigg , Ruth R. Chung & Randall J. Souviney (2005). Performance Assessment and Electronic Portfolios: Their Effect on Teacher Learning and Education, The Clearing House: *A Journal of Educational Strategies*, 78(4), 164-176, DOI: 10.3200/TCHS.78.4.164-176.
- Santos, L. & Pinto, J. (2010). The use of feedback in written reports and portfolio: an assessment for learning strategy. *Research in Mathematical Education*, 14(3), 281-297.
- Santos, L. M. (2020). Pre-service teachers' pedagogical development through the peer observation professional development program. *South African Journal of Education*, 40(3), 1-12. <https://doi.org/10.15700/saje.v40n3a1794>.