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USING (E)-PORTFOLIO IN LEARNING TECHNICAL SUBJECTS IN PRESCHOOL AND PRIMARY SCHOOL

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Abstract

Scientific, technological, and engineering education are gaining ground in the educational system in various countries, on the one hand, because these domains characterize the environment in which we live, and on the other hand, because of the students' lack of interest in studying them. This disinterest also regards the professionalization in these areas/domains. The foundations of science, technology, and engineering education must be built/ traced from an early age (preschool and primary levels). Students should gradually become familiar with specific concepts, skills, and reasoning. There is a whole arsenal of scientific methods that can be adapted to technological and engineering education too: observation, experiment, inquiry learning, problematization, and problem-based learning, portfolio, etc. This study presents the results of a research based on the experiences of the participants regarding portfolios made for learning school subjects such as science, engineering and technology. The participants were future teachers for primary and preschool education, respectively, teachers with various specializations, participants in a training program to become teachers for the mentioned levels (professional retraining). The research question was whether there are differences between the opinions concerning portfolios of two samples of participants and the typology of these differences.

Keywords: Engineering education, portfolio, preschool, primary school, scientific education, technological education, teachers

1. Introduction

Science refers to the body of knowledge about natural, social and man-made phenomena obtained through observation and experimentation (Lindberg, 2010) in order to understand the causes and occurrence of natural phenomena.

Brooks (1994) considers science to be the foundation of technology because its development stems from the knowledge and advances made in science. Technology is the means to a human end (Brian, 2009) and engineering involves the use of technology with the help of the individual's imagination, judgement and knowledge.

Pupils' familiarity with scientific knowledge begins at the pre-school level when the teacher introduces children to various simple experiments. In primary education, pupils are taught the 'scientific method': formulating problems and questions, documenting from various sources, formulating hypotheses or predictions, testing predictions using two samples, reformulating the hypothesis if the results do not confirm the predictions made, and repeating the experimental approach to check whether the hypotheses made are supported by the results obtained. The teacher prepares the students in the scientific method by conducting experiments and making empirical or systematic observations.

Technology and engineering provide pre-school and primary school pupils (including their older peers) with contact with different materials, production technologies, products or technological processes. Familiarity with the diversity of natural materials (e.g. wood, straw, stones, wool, etc.) or materials produced by humans through various technological processes (e.g. oil, cement, bricks, wire, prefabricated products, etc.) is important for engineering and technology education. Understanding the process of producing artifacts is the task of the technologist and making complex products and designing processes is the task of the engineer. For example, the design of an oil press is the job of the mechatronics and automation engineer, the oil press construction and the oil production is the job of the technologist. For younger students, watching a documentary film about ice cream production or packaging can help them differentiate between the jobs of engineer and technologist. Visits to museums with technical exhibits, visits to business institutions, watching films, studying encyclopedias, talking with parents working as scientists, engineers, technologists/technicians, doctors, etc. help children understand the evolution of society, the need for a general or STEM culture and the limits of thinking at a time.

Portfolio is a method and also an instrument frequently used in science, technology, and engineering education. As a learning method, the portfolio involves compiling a collection of materials for the subject or topic being studied. As a tool, the portfolio is made up of a collection of materials that highlight students' progress (Paulson et al., 1991), their strengths and weaknesses (Tierney et al., 1991), reflections of their own actions and results (Smith & Tillema, 2003) and the level reached in achieving certain outcomes (Miller & Singleton, 2002).

In terms of the typology of the portfolio used in the learning process, it can be documentation, reflection, assessment, communication, and evaluation (Ladage & Chevallard, 2008). Abrami and Barrett (2005) classify portfolios into (i) portfolios storing information, (ii) portfolios collecting learning products, (iii) portfolios illustrating the learning process, and (iv) portfolios as workspaces. Barrett (2007)

groups portfolios into learning, presentation, and assessment portfolios. According to Nastas (2013), the typology of portfolio includes educational, professional, individual, and group portfolio.

Barrett (2007) identifies the stages of portfolio making: (a) designing the structure of the portfolio and developing criteria for the presentation of individual products placed in the portfolio, (b) collecting materials, developing work assignments, relating learning artifacts, (c) the aggregate of these materials (n.a. the portfolio), (d) presenting the portfolio, collecting feedback, and (e) reviewing the portfolio. Developing the structure of the portfolio can be the teacher's task, or students can be involved (Stoica, 2001). The whole process of developing a portfolio is coupled with reflection.

Prendes and Sanchez (2008) identify six steps for implementing the portfolio in the learning process: providing information on the purpose, materials, process, and assessment criteria, setting the number of materials that can be included in the portfolio, presenting the assessment criteria, specifying the time allocated for its implementation, self-reflection processes and presenting other information that facilitates the implementation of the portfolio.

Regarding the materials that can be included in a portfolio, Mazilescu (2019) states that they can be written documents, photographs, and multimedia elements. Bocoș (2017) adds to the list of components "formalized" and "non-formalized" assessment tools, i.e., grids, worksheets, and, respectively, teacher's observations and parents' remarks. The portfolio may also contain audio-visual material, summaries, essays, worksheets, homework, or projects. In the case of e-portfolio documentary materials are collected from the Web, developed by using appropriate multimedia and software, stored digitally and available on a website or delivered by CD/DVD (Butler et al., 2006, p.10).

The teacher assesses the portfolio by awarding marks or grades on the basis of the achievement of the proposed objectives, the quality of the materials included, the degree of complexity of the tasks involved in the portfolio, the minimum number of works completed, originality, creativity, reflection on the tasks, etc. This assessment can be of two types: on the whole portfolio or part of it, on part of the portfolio, or on the completion of a task included in the portfolio. The first type of assessment involves the marking of the whole portfolio completed by the students, while in the second case, either individual components or each task completed is marked and the mark is calculated as an arithmetic average, weighted average, etc.

The advantages of portfolio development include more explicit communication between peers or with the teacher, motivation of pupils in learning, self-assessment, cooperation, empowerment, use for each subject, illustration of learning process and progress while the disadvantages include the long time needed to complete the portfolio, the difficulty of assessing the portfolio and its adaptation to the age and individual characteristics of pupils.

2.   Problem Statement

- ▪ Portfolios are frequently used in universities, especially in theoretical school subjects. Students are required to create portfolios, but there is no uniform view of the structure of the portfolio and the steps to be taken to produce it. Teachers teaching at different levels of pre-university education ask their students to produce portfolios. These can be structured or unstructured. The vast majority are portfolios on paper. Some studies have compared the views of prospective

teachers with those of teachers on e-portfolios. In this study, our aim is to disentangle these opinions.

3. Research Questions

The research question was whether there are differences in the views on portfolio/ e-portfolio between student teachers who are prospective primary and pre-school teachers and student teachers with different specializations and teaching experience who aspire to become primary and pre-school teachers. Students in the first category had contact with the portfolio method as students (school and university students). Subjects in the second category came into contact with the portfolio method as teachers, as students at the faculties at which they obtained their first specialization, and at students following the courses for the specialization Primary and Pre-school Pedagogy.

4. Purpose of the Study

The aim of this qualitative study was to identify and compare the opinions of two samples of subjects with different backgrounds/experiences on portfolio issues (portfolio content and its making) in general and e-portfolio in particular.

5. Research Methods

The present research consisted of a questionnaire-based survey that was conducted between May 2021 and June 2021. Two samples of subjects participated in the research. The first sample included students – future teachers for primary and preschool education. The second group of respondents included students – teachers with various university majors who are undergoing a retraining program to become primary and preschool teachers. Convenience sampling was used.

5.1. The research instrument

The instrument used in the research was a 20-item questionnaire (14 multiple choice items and six open-ended items) that aimed to identify differences in portfolio opinions between the two groups of study participants. The survey was available online on Google Drive and was completed on a voluntary basis. Respondents were asked to rank on a Likert-type scale from 1 to 5 (1-totally disagree, 5-totally agree) each statement in the survey. The data was processed by calculating the means, standard deviation and sum of the percentages representing total and partial agreement and total and partial disagreement. A t-test was used to compare the means of the two samples of subjects.

5.2. Participants

The vast majority of the respondents (97.7%) were women. Most of the respondents were aged 19-24 (95.3%) and only 4.7% were in the 25-29 age group. In terms of their teaching experience, 4.7% have less than 5 years of experience and 1.2% have between 5 and 9 years of experience. 65 respondents are

students and the rest are teachers with different specializations who want to become primary and pre-school teachers.

6. Findings

In the present study, the aim was to identify the views of the participants on the stages of portfolio development and portfolio content.

6.1. Respondents' views on the portfolio content

The questionnaire included a free response item on the content of the teacher's portfolio developed to familiarize primary school students with science, technology and engineering: (i) short description of the physical properties of materials (natural or artificial i.e. wood, straw, bricks, water, magnets, steel, water, plastic, etc.); (ii) description of the process of obtaining a material (i.e. papier-mâché, clay brick, etc.) or working techniques (i.e. cutting, gluing, origami, quiling, weaving, etc.); (iii) description of apparatus and instruments used in technological processes (i.e. potter's wheel, watermill, balance); (iv) designs of hand-made products (i.e. buildings, cable bridges, etc.); (v) hand-made products which illustrate real objects (i.e. boat with paddle propulsion, hovercraft, cable-stayed bridge, pyramid, etc.); (vi) observations or experiments on scientific phenomena or processes (i.e. water cycle in nature, dissolution, inertia, floating etc.); (vii) worksheets describing the steps of the product making; (viii) stories, poems, riddles, proverbs, sayings, songs, etc. and compositions. Also, a portfolio can contain a short description of the mental and emotional state of the person making the portfolio, of his feelings during the manufacture of the products.

The e-portfolio may contain drawings, films, video-recordings, audio-recordings or animations, explaining how to make or use a product. The electronic portfolio may be hosted on a website or blog.

In the case of the portfolios required of primary school pupils, the subjects state that the products required of pupils should be varied or accompanied by as varied material as possible (films, stories, compositions, etc.)

6.2. Respondents' views on the production of the portfolio

Subjects involved in the research recognize the importance of the portfolio for easy assimilation of subject-specific information (90.81%), stimulation in connecting ideas (91.96%), and in-depth thinking (90.08%). A high percentage is also recorded for the item on recommending the portfolio in the learning process (90.08%). Other benefits of portfolio making are shown in Table 1.

Table 1. Portfolio benefits

Item	N	M	StDev	Disagree (%)	Agree (%)
Working on the e-portfolio helped me to assimilate the subject-specific information more easily.	86	4.35	.68160	1.1 5%	901 %
I was more stimulated and engaged in the course content by the thought of having to produce an e-Portfolio.	86	4.17	.78068	3.45 %	83.9 %

Making the e-Portfolio for the course stimulated me to connect my ideas.	86	4.35	.69845	2.30 %	91.96 %
Making the e-Portfolio for the course helped me think more deeply about the course content.	86	4.20	.63131	1.15%	90.08 %
Making the e-Portfolio for the course helped me examine my writing process better.	86	3.82	.79544	2.30%	63.22%
Making the e-Portfolio for the course helped me examine my learning process.	86	4.17	.73464	3.45%	87.35%
Using an e-Portfolio in the course has allowed me to be more aware of my development as a student.	86	4.16	.81944	4.60%	82.76%
Making the e-portfolio helped me understand what I needed to do to become a better teacher/student.	86	4.04	.87482	4.60%	77.01%
I would also recommend other students to make an e-Portfolio when learning.	86	4.49	.69673	1.15%	90.08%

Regarding the benefits of the portfolio, there are four items with high percentages of agreement (see Table 2): stimulating creativity (96.51%), improving technical skills (94.26%), self-awareness (85.05%), and working with pleasure (97.7%).

Table 2. Portfolio benefits - items on which there is no disagreement

Item	N	m	StDev	Disagree (%)	Agree (%)
I enjoyed creating the e-portfolio.	86	4.83	.428	0%	97.7 %
Building the e-Portfolio helped me learn about myself.	86	4.16	.663	0 %	85.05 %
Making the e-Portfolio for the course stimulated my creativity.	86	4.73	.516	0 %	96.51 %
Making the e-Portfolio for the course helped me to improve my technical/computer skills.	86	4.40	.600	0%	94.26%

Table 3 contains the means of the sample of subjects and the means of each category of respondents (m_t- teachers and m_s-students).

Table 3. Sample means of subjects and group means of teachers and students

Item	N	m	StDev	m_t	StDev	m_s	StDev
I enjoyed working on the e-portfolio.	86	4.17	.654	4.19	.602	.602	.675
Building the e-Portfolio helped me learn about myself.	86	4.37	.669	4.33	.577	.577	.700
Working on the electronic portfolio helped me to more easily assimilate the information specific to the subject for which it was made.	86	4.20	.749	4.24	.700	.700	.768
I was more stimulated and involved in the course content by the thought of having to make an e-Portfolio.	86	4.38	.654	4.33	.577	.577	.680
Making the e-Portfolio for the course stimulated me to connect my ideas	86	4.22	.621	4.24	.539	.539	.649
Making the e-Portfolio for the course helped me think more deeply about the course content.	86	3.84	.795	3.76	.768	.768	808
Making the e-Portfolio for the course helped me examine my writing process better	86	4.20	.700	4.19	.602	.602	.733
Making an e-Portfolio for the course helped me	86	4.76	.484	4.76	.436	.436	.501

examine my learning process.							
Making the e-Portfolio for the course stimulated my creativity.	86	4.19	.790	4.29	.561	.561	.852
Using an e-Portfolio in the course allowed me to be more aware of my development as a student.	86	4.06	.873	4.19	.680	.680	.927
Making the e-Portfolio has helped me understand what I need to do to become a better teacher/student.	86	4.42	.583	4.52	.512	.512	.604
Making an e-Portfolio for the course helped me improve my technical/computer skills.	86	4.51	.682	4.67	.483	.483	.731

Applying the t-test for independent samples shows that there are no significant differences between the means of the two subjects' samples.

In constructing an electronic portfolio, respondents were asked to select the time allocated to assemble the portfolio. 66.3% of respondents indicate 3-5 hours, 20.9% chose 6-10 hours and 12.8% select one hour.

Regarding the purpose of the portfolio (free response item) most respondents say that it can be to stimulate creativity and imagination, highlight work and progress in learning, evaluate effectively, accumulate new information, improve technical skills, develop skills, motivate learning, develop motor skills, fix and consolidate information, combine theory with practice, pay attention to detail, help in teaching and self-evaluation.

In the respondents' opinion, the most interesting part of making the portfolio was reviewing knowledge, composing or finding stories, riddles, songs, poems, etc. In the case of material products, the most challenging tasks are making materials, analyzing working methods, making components, and assembling the portfolio. The most difficult part was solving technical problems that arose when making the products or computer materials that accompany the making of the product (i.e. filming the process of making a product).

7. Conclusion

The respondents recognize the importance of the portfolio in the study of science, engineering, and technology topics. They particularly appreciate the importance of the electronic portfolio, which allows the use of a wide variety of materials of different types. Among the difficulties encountered by respondents in creating the portfolio are those relating to the lack of knowledge in the field of engineering and technology, and the inability to use digital instrumentation.

We recommend the introduction of the academic subject of Engineering and its didactics in the curriculum of primary and pre-school future teachers, who are already studying Technology and its didactics. We consider very important the introduction of a discipline of technological and engineering education in the primary school curriculum that will help students develop their knowledge about the world in which they live.

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