The Design, Implementation and Evaluation of a Web-based Student Teachers' ePortfolio (STeP)

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ABSTRACT: *This paper presents the development process of a web-based student teachers' ePortfolio system for the Faculty of Education at the University of Malta. Literature shows that at a higher educational level, a student ePortfolio is becoming an important tool as it is being used to enhance the learning process through constant tutor and peer feedback, self-regulation and reflection. Many ePortfolio applications exist that may help university faculties to collaborate with their students. However, these existing applications concentrate on general ePortfolio content and allow limited flexibility to be tailored to specific structured ePortfolios that is actually needed by the demanding faculty. In our opinion a new tailor-made structured ePortfolio is needed specifically to replace the manual professional development portfolio system. The proposed system will be the official ePortfolio for the Faculty of Education to be used compulsory by students that are reading a bachelors degree in Education with a secondary track at the University of Malta. Therefore we proposed the full lifecycle development of a new web-based student teachers' ePortfolio which we call STeP. A sample of fifteen selected participants, which include the chairperson of the Professional Development Portfolio, an administrator, tutors and students have taken part in different stages of the software development and played an important role in its success. We show all the stages involved that led to the successful implementation of the proposed tailor-made ePortfolio system. We evaluate our system and present a qualitative outcome for its implementation.*

Keywords: ePortfolio, Reflection, Self-regulation, Students' Artefacts, Peer feedback, Web-Application

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1. Introduction

Over the past years, in many educational institutions worldwide, various attempts have been made to improve teacher's performance and competence in instruction [cf. 4, 12, 23, 35]. In fact, there has been a growing interest in teacher professional development with the curriculum reform and social development, and it is one of the most important issues in education reform today [44]. To enhance competence and improve professional development, teachers must reflect critically on the actions performed in instruction. In fact several studies showed that when teachers reflect, they enhance the repertoire of pedagogical

knowledge and to enhance their pedagogical knowledge, prospective teachers rely only on cooperating teachers and university supervisors to provide them with feedback about their work [29]. This is in line with the teaching undergraduate course offered at the University of Malta. However, in the local context student teachers are encouraged to initiate self-assessment and reflection by developing a portfolio through the PDP (Professional Development Portfolio) sessions as part of the course. However, when teachers graduate and start their teaching career, for many of them the portfolio becomes an extra burden.

While foreign research has accounted for the digitization of teachers' development in a portfolio referred to as ePortfolios (electronic-portfolios) [cf. 21, 22, 29, 36, 37, 39, 43], in the local Maltese context very little research attempts have yet been carried out on the development and implementation of teachers' ePortfolios. Thus, a great interest arose to create an ePortfolio to assist teachers in enhancing their professional development from the early days of their teaching course. This thus justifies designing, implementing and evaluating a web-based STeP (Student Teachers' ePortfolio) in the local context at the University of Malta. This research and development is particularly aimed to give birth and shed new light on the introduction of ePortfolios for all student teachers to help them become reflective practitioners and more competent in their work before starting their teaching career. The objectives of our web-based STeP is first and foremost to enhance teachers' professional development, enable easy access to personal teaching records anywhere via the Internet, allow authorized personnel to assess students' work, organize teachers' work efficiently, provide an easy to use user interface (UI) to encourage student teachers to personalize their own data and share their professional knowledge and competences with trusted partners.

To start this new project, we have based our thinking on three major assumptions: (1) problems in the design and implementation to transform a paper-based format portfolio to a new complete and secure ePortfolio system that will have an approximately hundred new users per year; (2) problems regarding hosting and storage that may crop up within the IT Web Services Department at the University of Malta where the ePortfolio will be hosted; and (3) shifting from a paper based ePortfolio may require consistent re-evaluation not only in terms of digital learning but also in terms of students' success and perspective towards the new ePortfolio system, interaction and confidence.

With this in mind, we have established these research questions: How do the students and Faculty view the professional development portfolio in its current form? How do they view the possibility of a shift to an online ePortfolio system? What changes need to be made in the design and implementation of the current portfolio and how can a shift to an online system, help achieve the required changes? What will be the perspective of all the tutors involved in using the system to assess their students in their professional development portfolio module? What will be the impact on students' engagement of a shift to an ePortfolio? What support will students and tutors at the Faculty of Education get during and after a transition to the new ePortfolio? How can students be better integrated to continue using the new ePortfolio in their final year of their course and beyond?

To sum up, this research will describe all the stages involved in the development of a web-based ePortfolio for all student teachers reading a teaching degree at the Faculty of Education at the University of Malta. The research will involve students, tutors, an administrator and the chairperson of the PDP (Professional Development Professional) committee from the same Faculty to help in the software development stages of the new web-based Student Teachers' ePortfolio (STeP). The research will also establish system content and its environmental architecture for a highly personalized web-based teaching ePortfolio system that will be used by the same Faculty to demonstrate teaching practices, reflections, management and growth.

2. Review of Literature

2.1 Portfolio use in Education

In education, the last decades showed various universities, programs and courses moving from paper to ePortfolios [33]. This is evident since ePortfolios provide numerous positives for all parties involved. Literature shows two main types of portfolio use in education. These are the teacher portfolio to enhance professional development and the student portfolio to assess the learning progress [cf. 5, 6, 13, 22, 30, 37].

2.2 Portfolio use in the local context

Currently, student teachers reading a teaching degree in education at the University of Malta, have to take a compulsory module which is the PDP to support them and become reflective practitioners. This module was first introduced for the secondary students in 2001 [7] and has become an integral part of the development of the teacher's identity as a continuous professional development process [8]. In a constructivist approach, future teachers will better their skills in reflective writing, assess their

own work and improve their professional teaching methodologies in a limited way. The current PDP also helps students in having a showcase in a hardcopy form of their working achievements after they complete their undergraduate course.

Despite the benefits of the current use of the manual portfolio, it often lacks proper manageability, proper monitoring of students' work, is not portable, has no secured storage facility and may be easily lost. Additionally feedback on students' reflective writings may be posted late by PDP tutors or simply does not exist, thus not helping in a timed reflection coaching process to help students improve their reflective writing skills, and finally give ease of accessibility. One solution to this problem is converting and upgrading the current portfolio in a digitized online version of an ePortfolio.

2.3 Defining ePortfolios and the teacher professional development ePortfolio

Literature shows that three types of ePortfolios exist: (1) a showcase ePortfolio; to organize work after it is created; (2) a structured ePortfolio; to help reorganize work before it is created; and (3) a learning ePortfolio; which evolves as work is created [16, 38]. However, in general, an ePortfolio is a "p*ersonalized Web-based collection of work, responses to work, and reflections that are used to demonstrate key skills and accomplishments for a variety of contexts and time periods*" (p. 2) [26].

In the teaching profession, professional development portfolios have been in use for many years to help teachers examine their professional practice and reflect on their growth over time [11]. With the availability of new technologies, ePortfolios are currently receiving significant attention in higher educational levels, institutions and universities to support the learning process and assessment [42]. Many institutions offering teaching courses are developing digital portfolios to allow greater portability and sharing, to provide an avenue for student teachers to reflect on their practice and to offer the possibility for students to receive feedback and support from their tutors and trusted colleagues [4]. Indeed these teacher ePortfolios will help student teachers to reflect critically, to improve their teaching qualities and pedagogies and to be able to be autonomous learners [4]. Indeed when students reflect on ePortfolios for professional development, they grow in their skill and practice [4, 26].

Although the implementation of ePortfolios has been a success in many educational areas, it is evident that the strongest movement in ePortfolio implementation within higher education has been within the colleges of teacher education, as the digital teaching portfolio is the only tool that offers opportunities for connection, collaboration, reflection and evaluation [4]. Additionally, the digital portfolio (a) uncovers strengths and weaknesses for growth and development, (b) helps a teacher reflect on learning and, (c) allows for a wide range of learning styles to be addressed and shared [4]. Furthermore, teachers involved in creating reflective digital portfolios develop technology-related skills that have a transfer to the classroom [4].

2.4 The benefits of using ePortfolios in Education

Various studies have mentioned many benefits students gain when using ePortfolios [cf. 18, 32, 33]. One of the most significant benefits is that students become the co-owner of their own learning which goes beyond the concept of a certified record [32]. Additionally, since ePortfolios are meant to enhance a learner-centric approach, ePortfolios facilitate the promotion of conceptual thinking about learning as an ongoing process [41], promote reform of the traditional educational system, bridge the divide between the academy and society, and develop social capital for the best interest of the global community [1].

EPortfolios can be used as a tool to promote development and learning, can foster self-regulated learning and motivation, and can also serve as a framework for inducing a more effective goal orientated approach [2]. Pintrich in [2] identifies four stages of self-regulated learning: goal-setting, monitoring, regulation and reflection. To promote self-regulation it is suggested to integrate these four stages in ePortfolio design and development while to enhance self-regulation, it is suggested prompting students to outline strategies (the when, where and how) for attaining each of their goals [2]. However, since many students are incapable of self-assessment, an ePortfolio should help provide students with guidelines for self-assessment by incorporating examples of self-reflection and guidelines regarding how to prepare a reflective writing and prompt feedback [2]. Without reflection, the ePortfolio becomes merely storage [33].

As reflection is becoming one vital component that should be included in ePortfolios, many studies have been devoted to help students to reflect on their experiences and to improve on their professional growth [cf. 7, 8, 18, 33, 48]. In fact, in higher education, it has been implicitly defined that students who are able to understand and engage in higher-order-thinking, reflect deeply and analyse critically are more likely to succeed than other students that do not have such of these opportunities [33]. In a teacher development ePortfolio, the ladder of reflection helps students how to reflect as it is a coaching process between the Faculty and the student [33]. Today ePortfolios can facilitate this ladder of reflection through an internal e-mail communication

system, messaging or discussion forums [33]. To integrate reflection in ePortfolios, all instructors should be trained to teach and assess reflection and portfolios [33] while at the same time they should provide clear objectives, modeling, monitoring, and feedback to facilitate the reflective learning process as ongoing feedback is essential to help students posting successful reflective writings [38].

EPortfolios can be designed to allow peers to post feedback on each other's artefacts [38]. This may require more resources and loads of effort to decide how to best facilitate the exchange of peer feedback mechanism [38].

2.5 Implementing a successful ePortfolio

Various studies show successful attempts in the development and implementation of teacher ePortfolios [cf. 3, 15, 20, 28]. Many are a result of joint project development between the institution and developers to set up a complete, reliable and attractive ePortfolio as required [4]. However, careful consideration of its implications must be considered and uniquely dealt with by each institution looking to adopt an ePortfolio system while at the same time, it is important to assess the Faculty resources that are needed to successfully implement a new ePortfolio [4].

Today many colleges and institutions are switching to web-based ePortfolio applications as through digitized formats and frameworks technology is offering the possibility to implement the ePortfolio with a wide range of contents and interactions between different users [14,29]. Indeed many studies suggested including videos in the teachers' ePortfolio as it is the best tool for teachers to actually evaluate their actions in instruction [cf. 29]. Other studies suggested sharing personal data with trusted partners [cf.22], while others emphasized the importance of assessing teacher's work between colleagues and by school leaders to provide different feedbacks and assessment [cf. 26, 43]. In many different countries such as in the UK [cf. 17], Wales [cf. 31], Scotland [34] and in the USA [cf. 5], the portfolio has become an important tool and forms part of the curriculum in many educational institutions.

Three important aspects that should be primarily considered for successful ePortfolio participation include (a) ways to encourage students' participation, (b) ensuring staff participation and development and (c) the content [4]. In fact to encourage students' participation, the Faculty must encourage students to participate fully in their professional development portfolio process [19]. Additionally the Faculty must clearly explain to its students the potential benefits in both short and long term that PDPs have, including links to meet their professional entry requirements while also allowing students the need to see that their effort and time spent in creating and maintaining their PDP was worth it. Moreover the Faculty should include from the start reflective examples and exercises to encourage student to think deeply and adopt a good practice at it while the main ePortfolio content should be properly tailored to meet the needs of the same Faculty or institution [19].

There is evidence that students like computers [10, 19, 40] so having a web-based system which is reliable, simple to use and update, user-friendly and tolerant of user's mistakes encourages more students to use the online system. As students may find it hard to be specific about what they need to develop, simpler and shorter forms to fill in the PDP content will get more students to complete successfully their ePortfolio [19]. In addition, to ensure staff participation, all the tutors must be convinced of the benefits of the online PDP, should be better equipped to support students, and should have a clear knowledge of how to guide students to help them in developing their PDPs to their full potential while at the same time suggesting new ways of improving it [19]. It is evident that the more students consult their PDP tutors, the better will their ePortfolio content be.

Finally to maintain successful ePortfolio system, the students should maintain control of their content by allowing peers, and mentors to give input while the instructor provides the opportunity for the interactions and assessment of the final outcomes [1].

2.6 The new Student Teachers' ePortfolio

Overall, the new student teachers' ePortfolio will be a state-of-the-art tailor-made web-based application to support the PDP module that is being taught at the Faculty of Education at the University of Malta. The main content of the new ePortfolio will be based on various analysis techniques that will be carried out with members of the same Faculty and supported by the literature carried out for the purpose of this study. Increasingly, STeP will target to change the way how the module is currently being taught and examined, lessen communication barriers between students and their PDP tutors, reduce paper work, store students' data online and provide a 24/7 online service to all its users. In addition, to provide room for further improvement, STeP will have a tailor-made Content Management System to allow the administrator to manage its content, users and user files.

With an underlying relational database architecture and embedded Structured Query Language in both Java Server Pages and Java Servlets, STeP will take the advantage to provide secure, reliable and robust ePortfolio web-based application that will allow students and tutors to interact safely together.

3. Analysis

As part of the analysis stage in the web-application development of the new ePortfolio for the Faculty of Education, a qualitative research approach to investigate the current manual PDP module was used. A sample of eight university students and the chairperson of the PDP in the name of all the PDP tutors participated in the analysis stage for the new ePortfolio system. We have conducted interviews with these participants who are using the current manual PDP and collected data by examining existing documentation that is being used [cf. 9]. After carrying out one-to-one interviews with all participants, we have analysed and interpreted the data by using a thematic approach to structure and organise content. We have involved the participants from the start of the project to focus on learning the meaning that participants possess about the current problem while at the same time creating multiple views of the problem. The results from the interviews and existing documentation enabled us to draw and finalize the software specification requirements needed for the new ePortfolio system. We have also set up and agreed on a tentative date for the implementation of the final ePortfolio system. Before started the design we have drawn a software specification requirements where we divided it into six major sections which include system overview, functionality, external interfaces, performance, attributes and design considerations.

As part of the system overview, we have established the type users which include students, tutors and the system administrator, the number of new users, which will exceed a total of approximately hundred new users per year, and listed the current problems students are facing with the current PDP module. Some of the problems include storage, misplacement and loss of information, bulky material, printing, cannot share their artefacts with others, cannot receive peer feedback or proper feedback on time from tutors or peers and late submissions. As part of the new system functionality we proposed to build three main different UI views. For the students' UI, we considered dividing the main ePortfolio interface into six major sections which are; (a) ePortfolio, (b) Philosophy, (c) Knowledge, (d) Process, (e) Qualities, and (f) Development. In this UI, students will be able to upload and remove any form of digitized file including reflective material in the mentioned sections, insert comments to tutors, unauthorise and authorise trusted colleagues to share individual files, read tutor feedback, access authorised friends' ePortfolio content and post feedback on their friends' work. The third UI is a tailor made Content Management System (CMS) to allow the system administrator to manage and delete existing pages, add, modify and remove unwanted users, upload and remove user files, add, modify and delete existing registrants, view user accounts, suspend/activate registrants, authorise user files, and assign students with tutors to assess their ePortfolio. The final UI is the tutors' UI where tutors will be able to select their assigned students, access their ePortfolio files, read their comments and post feedback. We have also designed to implement an automated e-mail mechanism when new accounts are created and another one to inform tutors when their students upload their files. We also agreed with the Faculty that the system will provide a very friendly user interfaces. With regards the external interfaces, we agreed that the ePortfolio will be hosted at the IT services at the University of Malta where all authorised users can use the ePortfolio system anytime. We have also agreed to provide security and integrity of confidential data, providing all content in English, validate all input data with meaningful messages and provide accurate output information. Finally, after consulting the chairperson on multiple occasions to finalize the software requirements, we have started designing the new ePortfolio system.

4. Design

To develop the entire ePortfolio system we have used a rapid iterative process based on ADDIE model (Figure 1). This model has been extensively used to support software development in similar projects [c.f. 5, 49, 50].

As part of the design process, we have prepared two main prototypes, considered which browser will suite most our web application and started the database design using an Entity Relationship diagram. Since the majority of the students use Google Chrome, we have considered using the latest JQuery functions that work best on this type of browser. After figuring out the database tables we have used Use Case diagrams to obtain the different users' roles. Then we started designing the CMS followed by the students' UI and then the tutors' UI. Each design also included a detailed descriptive function of each option with object sequence diagrams and flowcharts. These also enabled us figuring out which JavaServerPages and Java Servlets are needed for our ePortfolio web application. For each UI we have considered using an easy to use and difficult to misuse

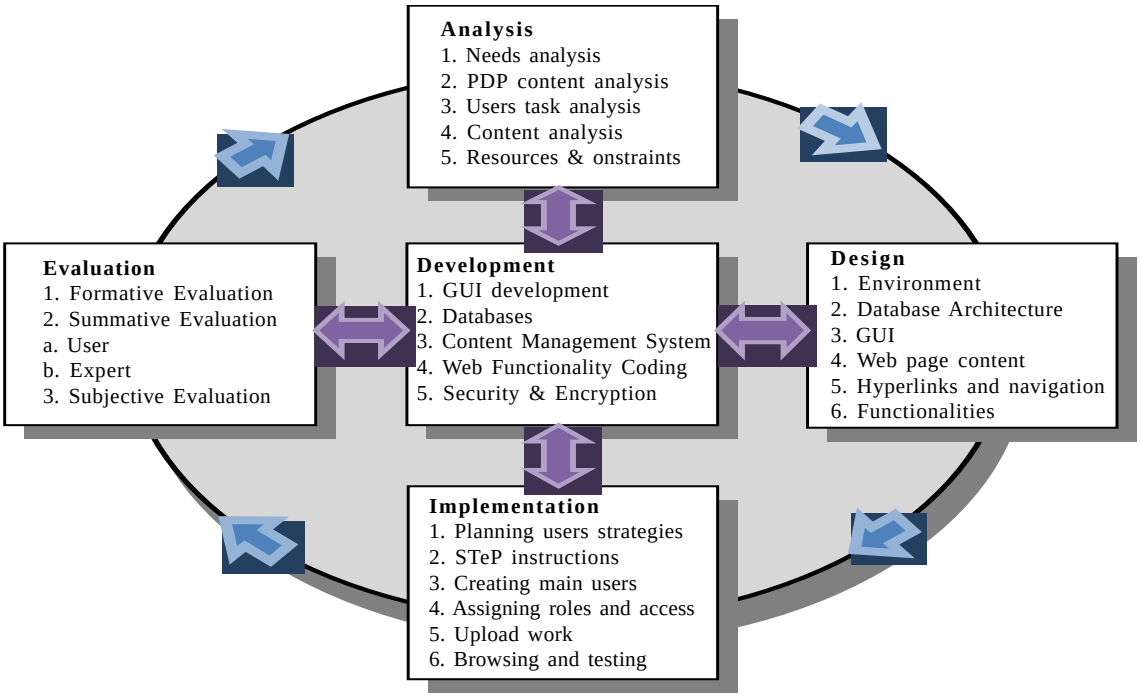

Figure 1. The model for developing the Web-based STeP application

screen layout, helpful prompts and minimum number of clicks to perform a particular task. In order to reduce response time between user actions and processed output, Ajax was utilized to perform partial page updates and to avoid reloading of pages. Finally we have planned the stages of system development, verified which languages to use and designed further testing strategies to test the software during development and after implementation.

5. System Development

STeP was developed on NetBeans IDE V7.01 using Java, JavaServerPages, JavaScript, HTML, CSS and JQuery functions. Ajax technology was utilised to perform partial web page data updates. We have created the database which consists of 16 related tables on SQLYog using MySQL. After the database development we started building and testing the CMS and all its options. Later we have developed the students' UI where we have implemented and modified a JQuery menu [66] and also finalised the sections and main content of the students' ePortfolio as suggested by the Faculty of Education. During the coding process we have corresponded regularly with the chairperson of the PDP to ensure that the whole project is being developed according to the user's requirements and satisfaction. Each function developed was thoroughly tested using different valid, invalid and extreme test data.

When the new ePortfolio was finalised, we have modified the login procedure to include an existing standard set by the IT services. This will validate university student accounts before registering for a new ePortfolio user account. This procedure ensured that only authorised users will be able to use the new Student Teachers' ePortfolio. STeP was introduced directly and we offered the full support when the system started running for the first time. The new ePortfolio is now hosted at the IT services at the University of Malta and can be accessed by on https://educeport.research.um.edu.mt/. It is the official ePortfolio system of the Faculty of Education for the PDP module and is being used by students who are reading a teaching degree course with the same Faculty for the first time. We have successfully implemented and tested the new ePortfolio system online before our projected implementation date last February.

6. Evaluation

To evaluate successfully the new ePortfolio, a qualitative approach as described in [24, 25] was used. We retained the same sample of eight students and the chairperson of the PDP while also involved five more PDP tutors and the administrator. We also ensured that at least one of the tutors teaches computing to provide us with an expert evaluation from a computing perspective.

With each participant we carried out different exercise tasks and conducted one-to-one interviews. During each exercise, we have observed each participant using the new system for the first time and recorded any events that took place. Despite the minor hitches and with only small interventions, we can conclude that the majority of the participants did very well in these exercises. The majority of the participants were confident and pleased with the new ePortfolio. After completing each exercise we carried out one-to-one interviews with each participant using a set of sixteen questions [c.f. 51] to evaluate system usefulness, ease-of-use, ease of learning and satisfaction. We have also prepared another interview to be carried out with the chairperson of the PDP to conduct an overall subjective evaluation. Finally we have transcribed all interviews and used a thematic approach [c.f. 24, 25] to carry out a successful evaluation as follows.

6.1 Usefulness

The students agreed that the new ePortfolio helps them to make their work easier, more productive and efficient. They all liked the idea of sharing their personal resources with their trusted colleagues and revoking the access permission given to their files anytime. In addition, tutors also agreed that the new ePortfolio saves time, has to do away with the paper work and there is no need to carry files around. The administrator also agreed that the CMS is user friendly, flexible and helps accomplish tasks easier.

6.2 Ease-of-use

All the students agreed that the new ePortfolio has a very user friendly interface, is divided into meaningful sections and limits the chance for misuse and for any navigational difficulties. However, one student preferred a lighter background and suggested having an option to change the colour background to the user's likings. The tutors agreed that to accomplish the required task is easier and faster than the manual system. None of the tutors recommended any changes to enhance the usability of the new software. On the contrary, all of them agreed that the new ePortfolio is easy to use, intuitive, user friendly, and is neither complex nor cluttered. However, one tutor mentioned the need to have the facility to upload files to their students.

6.3 Ease-of-learning

The students agreed that no skills to learn to use the ePortfolio are required. Some mentioned having some experience with Internet navigation and basic computer skills would be enough. Although the majority of the tutors agreed that the new ePortfolio required no special skills and is very easy to learn, some mentioned that it will take them some minutes to learn how to use the new software. The administrator also found the CMS easy to learn and use, while also mentioning the need to have some Internet basic skills.

6.4 Satisfaction

The majority of the students agreed that nothing is needed to improve the user interface as it is already very user friendly and easy to use. All the students also mentioned that they will definitely use the new software and would recommend it to others. Overall we can conclude that all the students are very satisfied with the new ePortfolio system. Finally all the tutors agreed that they are satisfied with the new ePortfolio and it provides a positive feedback. Almost all tutors agreed that nothing else is needed to the user interface of the new software. However, one tutor mentioned the need of allowing an option to change colour background. Finally all tutors agreed that they will definitely use the software and are very satisfied with the new ePortfolio system.

After analysing the chairperson's interview, we can conclude that he is very satisfied with the whole project. He mentioned that all the user interfaces implemented are all very user friendly and that the ePortfolio has met all the software specifications requirements as agreed in the analysis stage of this study. He is confident that the new ePortfolio will encourage students to take the PDP module more seriously, reflect better on their work and students will find it easy to learn and easy to use. He also said that the comments and feedback mechanism will enhance the relationship among students and tutors and among the students themselves. Although he is afraid of plagiarism, he is confident that students will learn more as they can share their personal files and their ideas with their trusted colleagues in a more critical way. He also liked the idea of having an automatic e-mail file upload notification when students upload their files and added that this avoids students uploading material at the very last moments. The chairperson also agreed that the new system will have a positive impact on students as it allows more collaboration, sharing of ideas, critical analysis, communication between students themselves and communication between students and tutors. Furthermore he also added that it will have a positive impact on the tutors as it will help them become more efficient and practical in their approach. Finally he suggested having a section where students will compile their work once they are ready from their course. We can also conclude that the chairperson is overall satisfied with the new ePortfolio system and with the fact that the deadline to implement the new ePortfolio system has been successfully.

5. Conclusion

Our study, tested and implemented, also propelled for further research and development in both the computing field and in education research. For the tentative developer we propose integrating STeP to allow employed teachers to act as mentors and post comments to current students' ePortfolio content, while for the educational researcher we propose areas to be further investigated such as; (a) How many student teachers are using the ePortfolio system after they graduate? (b) What effect is peer feedback leaving on students who are using the ePortfolio? (c) With the new ePortfolio system, are student teachers writing their reflective tasks better? (d) Are student teachers increasing the quality of their teaching methods and resources with the sharing of personal files? (e) Is the students' attitude towards the PDP module better with the new ePortfolio system? (f) Does the ePortfolio really enhance the career of newly graduate teachers?

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