Developing a pedagogical framework for the design and the implementation of e-portfolios in educational practice

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Abstract. A theoretical framework for designing, implementing and researching students' engagement, learning, and personal development in e-portfolios is described in this article. After providing an overview of the research on e-portfolios in education, the paper analyses the theoretical foundations of e-portfolio learning. Following it proposes a conceptual and organizational framework for teachers and instructors a) to conceptualize principles of student motivation, self-directed learning and reflection, and b) to implement effective e-portfolio learning initiatives at secondary and higher education, and teacher professional development. Finally, the article presents representative case studies and good practice examples regarding the implementation of e-portfolio initiatives using different tools in various educational contexts and programs.

Keywords: e-portfolios, Web 2.0, pedagogical framework, e-learning design, personal learning environments

Introduction

Learning and pedagogical thinking, in both theory and practice, has changed over the past decades. Many advocated that the tremendous development in Information and Communications Technologies (ICT) has changed the way we think about learning theories, pedagogical strategies, learning activities and outcomes (Bonk & Zhang, 2008; Jonassen, 2006; Lave & Wenger, 1991; Stahl, Koschmann & Suthers, 2006). The demands of the 21st century education require the development of higher-order learning skills, such as critical thinking, evaluating, problem solving, creativity, communication and collaboration skills, and, above all, learning how to learn. In this context, ICT has the potential to transform learning objectives and classroom practice and move from the acquisition of information, rote learning and shallow coverage of content to active knowledge construction through authentic learning activities (Herrington & Kervin, 2007) and participatory environments (Dede, 2008; Ryberg & Christiansen, 2008; Wenger, McDermott & Snyder, 2002).

In the past decade, the nature of the Web and the way people access and use Web recourses has been fundamentally changed. The successful integration of e-learning and Web 2.0 tools in education is expected to exert a significant impact on students' learning, since it provides multiple opportunities for learner-centred environments and offers rich learning resources. It has been argued that Web 2.0 supports students' engagement, communication, active and collaborative learning, self-directed and lifelong learning, peer and self assessment, and responsiveness to individual needs (McLoughlin & Lee, 2010; Ravenscroft, 2009). In addition, Web 2.0 technologies allow learners to extend their experiential learning spaces (both physical and virtual) beyond the walls of the classroom, while they can bridge formal and informal learning spaces across school, home, and the wider community (Jimoyiannis, 2010; Siemens, 2005).

The need to change our notion of teaching and learning environments from time and space bound classroom places to flexible, participatory, networked and extended virtual spaces is widely acknowledged (Brown & Adler, 2008; Oblinger, 2006; Siemens, 2003). Undoubtedly, Web 2.0 technologies challenge and enable educational sector organizations, around the globe, to consider new opportunities and ways of delivering their education programs and adopt learner-centred models of pedagogy which offer adaptability, flexibility and personalisation while supporting individual, social and collaborative learning processes. The increasing interest about the potential for e-learning tools and technologies to support more learner-centred and personalised forms of learning has been prompted by both, national and institutional strategies for e-learning and lifelong learning initiatives (Becta, 2008; Jimoyiannis, Tsiotakis & Roussinos, 2011; Laurillard, 2002; Salmon, Jones & Armellini, 2008).

Among Web 2.0 tools, e-portfolios constitute a new means of enhancing e-learning in practice; they are becoming increasingly popular in tertiary education in Europe, America and Australasia to support learning and personal development (Barrett, 2007; Becta, 2007; JISC, 2008; Stefani, Mason & Pegler, 2007; Strivens, 2007). For example, the Australian e-portfolio Project (AeP, 2010) has revealed that e-portfolio practice is growing and developing in Australian universities with considerable cross-sector activity evolving.

Literature review indicates that, in the last years, e-portfolio systems are dynamically evolved and used in primary and secondary education (Chang & Tseng, 2011; Meyer et al., 2010; Wall et al., 2006), undergraduate and post-graduate education (Kabilan & Khan, 2012; Ng, White & McKay, 2009; von Konsky & Oliver, 2012), teacher education (Shepherd & Hannafin, 2009; Strudler & Wetzel, 2005) and continuing professional development (Lygo-Baker & Hatzipanagos, 2012).

In the last years, e-portfolios have become an important research topic in the last few years but, on the other hand, they are not thoroughly studied in their different-multiple dimensions. However, they still remain an open research problem. Limited research has been undertaken in relation to designing and implementing e-portfolios to support learning and personal development, and even less has considered the advantages, challenges, difficulties and support from the tutor and institutional perspectives (Chen & Chen, 2009; Peacock et al., 2010; Swan, 2009). In addition, Housego and Parker (2009) debated on their potential for learning by positioning e-portfolios in an integrated curriculum and suggesting changes in assessment practices. Shepherd and Skrabut (2011) advocated that, despite resources that teacher institutions have devoted to e-portfolios, most implementations are of limited duration. Moreover, they suggested that organizations should re-evaluate how e-portfolios are implemented in a context where sustained professional development and lifelong learning will remain competitive.

In addition, there is a need for both educators and institutions to clarify and develop a sound conceptual-organizational model outlining successful implementation of e-portfolios for learning purposes. This paper has the ambition to contribute to this direction by describing an integrated framework of using e-portfolios in practice. Consistent to existing theoretical approaches about portfolios (Barrett & Garrett, 2009; Stefani, Mason & Pegler, 2007), the proposed organizational model goes beyond the notion of e-portfolio as a space for collection and storage of *learning artefacts*. The corner stone of the proposed model is the notion that e-portfolio environments offer extended instruction, collaboration and learning spaces for the students. In addition, our organizational model places student *construction (constructivist actions)*, *reflection* and *collaboration* as the fundamental operational features which form a pedagogical link between instruction and learning spaces in e-portfolios.

The organization of the paper is as follows: The first section addresses both theoretical foundations and empirical review regarding e-portfolios and learning. The second section proposes a conceptual/organizational model to support effective e-portfolio educational experiences in practice. The third section presents representative case studies regarding the implementation of e-portfolios initiatives at the Department of Social and Educational Policy, using different tools in various educational programs. The findings are discussed and conclusions are drawn for educational practice and further research in the field.

Literature review

Over the past years, e-portfolios have slowly been gaining recognition and popularity in higher education as a platform allowing learners to collect, organise and present learning artefacts and as a personal learning and development tool. Users can learn through reflection, analysis and self-direction while they are able to demonstrate over time their accomplishments, work, creativity, skills, competencies and capabilities, for different purposes and audiences (Becta, 2007; Joyes, Gray & Hartnell-Young, 2009). Not surprisingly, many university carrier placement centres regard e-portfolios as an opportunity to link academic outcomes to workplace (Cohn & Hibbitts, 2004). Increasingly, many recognise that e-portfolios have potential benefits for both graduates and employers. This is because employers are expecting to obtain a more informed picture of a candidate than is usually provided by traditional curriculum vitae (BIHECC, 2007).

Student portfolios are commonly integrated in education programs because of their ability to provide opportunities for self-assessment, reflection and skills development (Bartlett & Sherry, 2006; Strudler & Wetzel, 2005; Wang, 2009). Meyer et al. (2010) reported on students' use of the ePEARL e-portfolio tool to support self-regulated learning. The findings from their study offered valuable insight into how the consistent and appropriate use of e-portfolios supported novel approaches to teaching and integrating technologies in the classroom. In addition, learner-centered e-portfolios impact student metacognitive abilities, literacy achievement, as well as developing key self-regulated skills. Chau & Cheng (2010) argued that e-portfolio mediated learning is consistent with the approach of independent learning. Their research findings regarding university students and instructors suggested that e-portfolios can serve conceptually as an independent learning tool, but there are also implementation challenges facing students, teachers and institutions.

Web-based portfolios have been used by university students to collect information, to communicate, to manage content and reflection when performing project work (Dennis, Hardy & White, 2006; Meyer, Sporer & Metscher, 2009). Barbera (2009) found that peer criticism led to increased revisions and higher quality artefacts when sixteen PhD students created and shared e-portfolios. Chambers and Wickersham (2007) found that students valued the ability to view peer portfolios because it assured them about their own work or provided alternative perspectives. An exploratory qualitative investigation, in a teacher education institution, reported on how the construction of participants' identities as teachers was shaped by their engagement with an electronic teaching portfolio practicum (Trent & Shroff, 2012).

Ng, White & McKay (2009) reported on the development of web database portfolio with Picture Archiving and Communication System (PACS) connectivity, which was effectively used in the implementation of an undergraduate radiography programme. The e-portfolio was well accepted by participant students and was suggested by the authors for continuing professional development in health education.

Senger & Kanthan (2012) recommend learning portfolios as a creative learning tool and assessment tool in higher education. Forty-one physical therapy students were asked to create a learning portfolio as a component of their pathology course. Evidence of students' learning was evaluated at the midterm and the final examination by a synchronous tripod of assessors (e.g. self, peer and instructor) used to provide both formative and summative evaluation.

Recent research indicates that e-portfolios have great potential for learning and they can be effective assessment tools (Barbera, 2009; Wang, 2009). Chang & Tseng (2011) examined the effect of a Web-based portfolio assessment system on the performance of senior high school students undertaking project-based learning activities. Their research findings indicated that e-portfolio had a statistically positive effect on self-perceived learning performance. However their study indicates that e-portfolios constitute an open research problem as far as the issues of affecting students' achievement and elevating peer assessment ability.

Reese and Levy (2009) argued that several trends in higher education shape the context in which e-portfolio implementation could be advantageous. Among these, e-portfolios can facilitate and document authentic learning experiences through students' participation in virtual communities of practice. Research findings indicated that e-portfolio integration benefited students in perceiving better communication between faculty and peers and experiencing increased feelings of connectedness within an entirely online program, and helped students to clarify program expectations (Bolliger & Shepherd, 2010). However, students without prior e-portfolio or reflection experience benefited the most.

Peacock et al. (2010) reported on higher education tutors' difficulties implementing an e-portfolio relating to moving paper-based assessed portfolios online, the legal issues of and the technical robustness and flexibility of systems. Barriers were identified regarding tutors' lack of understanding about personal development and reflection, and their role in the academic environment, initiative fatigue and lack of access to information technology.

Operational definitions of e-portfolios

Learning portfolios are not a new idea in education. Usually, they were considered as meaningful collections of students' pieces of work that represent and document their activities, products, efforts, progress, achievements and the skills they have developed in the context of a single course, a whole programme, a project etc. Traditionally, as portfolio is defined a purposeful collection of a student's work that demonstrates his efforts, progress and achievement in a given area over time (Paulson, Paulson & Meyer, 1991; Arter & Spandel, 1992; Barrett, 2005). This collection must include student's participation in selecting contents, the guidelines and criteria for selection, the criteria for judging merit, and evidence of student self-reflection. Stiggins (1994) has added that a portfolio is not just a form of assessment but also a means of communicating about student growth and development. In addition, professionals have a long history of creating portfolios to represent themselves and their work.

In traditional (printed mode) learning portfolios, students collect their work and assignments, present selected showcase examples and reflect on what they have learned. The critical component in a learning portfolio is students' *reflection* on individual pieces of work, usually called *artefacts*, as well as an overall reflection on the material included in the portfolio. In addition, teachers use this material, which exhibits students' growth and change over time, to design their learning support and to organize students' assessment, both formative and summative.

Therefore, an *e-portfolio* is a dynamic space maintained and created by a learner, a group of learners, a whole community or an institution, in the context of a particular educational initiative (formal or informal). It is an organized, aggregated and purposeful collection of digital artefacts on the Web (e.g. content material, ideas, evidence, reflections, feedback etc.), which are compilations of personal and professional work for documenting abilities, skills, learning, growth and development. In addition, an e-portfolio includes demonstrations, resources, accomplishments, articulated experiences, peer and collaborative feedback and assessment tools, which structure and display an overall view of the participants' knowledge, skills, interests, learning achievements and outcomes.

According to their traditional view, e-portfolios are considered as personally managed and owned by the learner, and items (or projections of the whole e-portfolio) can be *selectively shared* with other community members (e.g. peers, instructors, assessors or employers). However, Web 2.0 technologies allow enhancement of the e-portfolio conceptualization by embodying, among others, archiving, publishing, linking, sharing, communication and collaboration features (e.g. with tools like forums, blogs, wikis, content sharing etc.).

A number of terms describing learner-centred online environments, where learners have the opportunity to select and demonstrate evidence of learning and development, were found in the literature, such as electronic portfolios, e-portfolios (Stefani, Mason, & Pegler, 2007), digital portfolios, Webfolios (Love, McKeanan & Gathercoal, 2004), and eFolios (Cambridge, 2008). They used to describe electronic forms of portfolio assembled and managed by a learner, usually on the Web, to plan, organize and present his/her work and achievements. It may include different types of digital artefacts, information and evidence of learning (writing samples, content in multimedia formats, resources, research projects, discussion forums, observations by mentors and peers etc.).

The European Institute for e-learning defines e-portfolio as a personal digital collection of information describing and illustrating a person's learning, career, experiences and achievements (EIfEL, 2009). Apart from being viewed as a collection of digital artefacts which presents students' understanding and achievement, an e-portfolio is a student-oriented, creative and developmental process of planning, synthesising, sharing, discussing, reflecting, giving, receiving and responding to feedback (JISC, 2009). According to Zubizarreta (2008), e-portfolio is described as a flexible tool that engages students in a process of continuous reflection and collaboration focused on selective evidence of learning. The portfolio provides a critical opportunity for purposeful, mentored reflections and analysis of evidence for both improvement and assessment of students' learning.

Rooted in Dewey's ideas about experienced learning (Dewey, 1933), *reflection* is the most important component of an e-portfolio initiative. Reflection is a way of thinking about learning and helping individual learners to understand *what*, *how*, and *why they learn*. It is a form of *mental processing*, a form of thinking, that people use to fulfil a purpose or to achieve an anticipated outcome. According to Moon (1999) reflection is applied to relatively *complicated* or *unstructured ideas* for which there is not an obvious solution. Individuals reflect when they identify problems or events, evaluate their causes and modify practices. Instructors should require students' self-reflecting on the artefacts they add to the portfolio in a way to gain from the rich learning experience that an e-portfolio developmental process can provide.

Beyond this, however, it is critical to point out that e-portfolio refers to both, the *product* and *the process of learning*. An e-portfolio, as a product, provides a *personal space* where learners can collect the digital artefacts that present evidence of their experiences and achievements, thus articulating actual learning outcomes. As a process, it allows learners to move beyond

what they have learned, to consider *how* they have learned and to understand the connections inherent in the *creative*, *constructive* and *collaborative* process of learning. The e-portfolio has been recognised as an environment that can help students trace their own learning trajectories by providing multiple opportunities to demonstrate and reflect on learning outcomes and to enhance their educational experiences (Hallam & Creagh, 2010). The autonomy of portfolio development encourages students to reflect on personal experiences and concerns with a self-directed reflection that promotes a sense of ownership and motivation (Driessen & Norman, 2008).

Barrett (2005) outlined three general components of an e-portfolio development process: *content*, *purpose* and *process*. The content includes the evidence, e.g. learner's artefacts, presentations and reflections. The purpose includes the aims and the objectives for creating the portfolio, including learning, professional development, assessment and employment. The process includes the tools used, the sequence of activities, the rules established by the educational institution, the reflections that a learner exhibits during the dynamic development of portfolio constructs, the evaluation criteria (rubrics), peer collaboration and conversations about the portfolio.

On the other hand, Klenowski, Askew & Carnell (2006) outlined a framework for using e-portfolios for learning and assessment focusing on the factors determining the shift from the traditional view of a portfolio (as a collection of 'work' selected and organized by the student, with a written justification and self assessment) to a learning portfolio that focuses attention on the subject of learning and how the course-participant is learning, the purposes, effects of context, and emotional and social elements. They suggested three key learning components involved in the process of creating and maintaining an e-portfolio, namely *metacognition*, *critical reflection* and *collaboration*.

Similarly, Zubizarreta (2008) identified three fundamental components in student e-portfolios: *documentation*, *reflection* and *collaboration*. Documentation includes representative samples of students' accomplished work that provide tangible evidence of knowledge and skills development. Reflection is related to **s**tudents' critical thinking about their learning experience and developmental process. Meaningful reflection is best facilitated by peer collaboration and mentoring within a learning community.

In light of *learning objectives* the information contained in an e-portfolio includes an extensive collection of personal information, education history, artefacts of recognition (e.g. awards and certificates), coursework (e.g. assignments and projects), instructor and peer feedback and comments, reflective commentary, career goals and objectives, personal values and interests, and professional and volunteer development activities. Current descriptions of e-portfolio processes include also the concept of learners drawing from both *informal* and *formal learning* activities.

Types of e-portfolios

Literature indicates, in general, four types of e-portfolios applicable in educational practice (Abrami & Barrett, 2005; Greenberg, 2004; Stefani, Mason & Pegler, 2007):

Working portfolios: They aim to support students to develop, demonstrate and reflect on their own learning, in the context of a formal education program (Stefani, Manson & Pegler, 2007; JISC, 2008). Working portfolios are also known as process or development portfolios. They contain works in progress and support students' planning and organization, as well as their work, learning and personal development. They provide a means of tracking, planning and demonstrating students' advancement, learning and development of skills over a period

of time. Usually, they are considered as works in progress and include self-assessment, reflection and feedback elements.

Assessment portfolios: They provide a mean of assessment, other than standardised exams and testing, helping teachers to capture the multi-faceted, complex nature of student learning outcomes (Applegate & Irwin, 2012; Cummins & Davesne, 2009). Assessment portfolios can be used for final course or programme assessments, with the aim to demonstrate and evaluate student performance and competence for a particular subject area (Meeus, van Petegem & Engels, 2009). They are structured and standardized to evaluate students' content knowledge, skills and competencies, as defined by the programme standards and the learning objectives determined by the formal curriculum.

Presentation portfolios: The third type of e-portfolios is usually used to support professional development programmes. Usually, these portfolios are presented at the end of a course or a programme to show and highlight the quality of students' achievements, skills and competence. They can help graduates to demonstrate exemplary or project work, and their competence/employability skills to stakeholders or to potential employers, with the aim to gain a new position or employment (Yorke & Knight, 2005; Willis & Wilkie, 2009).

Hybrid portfolios: In practice, rarely an e-portfolio is strictly used for working, development, assessment or presentation purposes. Most e-portfolios are hybrids incorporating features of all the three types above.

According to their learning goals and the type of the educational programme they support, there are three different types of e-portfolios (Stefani, Mason & Pegler, 2007):

Course e-portfolio: It is assembled to support instructional and learning needs of the students attending a single course. The students document and reflect upon the ways in which they have met the outcomes of this particular course.

Programme e-portfolio: It documents completed work, the skills acquired by the students, and the outcomes they have met in an academic, professional development, employment or lifelong programme. Students (learners) can use a selection of their e-portfolio to show to prospective stakeholders or employers.

Institutional e-portfolio: This type of portfolio supports many courses and educational programmes of a whole institution, school or organization (von Konsky & Oliver, 2012). Individuals also record and present their achievements, extra-curricular and informal activities, future plans etc.

In conclusion, e-portfolios in educational practice are conceptualized as efficient learning environments promoting students' participation in thinking about a) content selecting and creating, b) objectives and criteria used, c) criteria for assessing the value of this content, and d) the evidence of their achievements, self-reflection and peer feedback. Properly designed e-portfolios can facilitate students' engagement, guidance and support, collaboration and reflection on their learning and lead to enhanced awareness of their own *learning strategies* and *needs*.

The educational affordances of e-portfolios

There are several reasons why schools, higher education and informal education institutions use e-portfolios in educational practice and, particularly, they integrate e-portfolios in their current e-learning programmes. The emerging educational applications of e-portfolios and

the consequent expected benefits, for both students and teachers, are rooted in their pedagogical characteristics and affordances:

Storage: e-portfolios offer enhanced physical space to store and keep a great amount of information, which is easily transferrable on removable media and to back-up files. Students can easily replace, update and extend their older work with minimal efforts.

Access: The information included in an e-portfolio is easily accessible from everywhere using just a browser, even through mobile devices, thus extending portfolio learning activities beyond the classroom boundaries.

Dynamic development: An e-portfolio is a dynamic, learner-centred, interactive and collaborative environment. Students do not just collect information. They have enhanced opportunities for interaction, group work, collaboration, reflection and community building. Once their work is planned and organized, they can easily add new content information to improve the quality of their products.

Linking and archiving: The various parts of the information and the artefacts included in e-portfolios can be easily archived and interconnected through hyperlinks. The ability of new e-portfolio systems to create links and archives overcomes the linearity of paper portfolios. Links allow personal collection of material to become more thoughtful and easily accessible to peers and to promote novel assessment processes.

Assessment: Students' portfolio work is directly related to specific, well-defined standards and criteria. e-portfolios demonstrate wider dimensions of learning than just paper-and-pencil reports or exercises. They offer an authentic assessment space for both, students and instructors, incorporating features of formative and summative assessment, and self and peer evaluation, which promote students' reflection, collaborative learning, self-directed learning and personal development.

ICT competence and skills: Finally, students gain lifelong ICT skills while editing their portfolio, creating digital artefacts, adding and sharing multimedia information, uploading commentaries, accessing and treating their personal space in the portfolio system.

Figure 1 represents the complexity and the interplay among the three constitutional components in e-portfolios as dynamic learning environments:

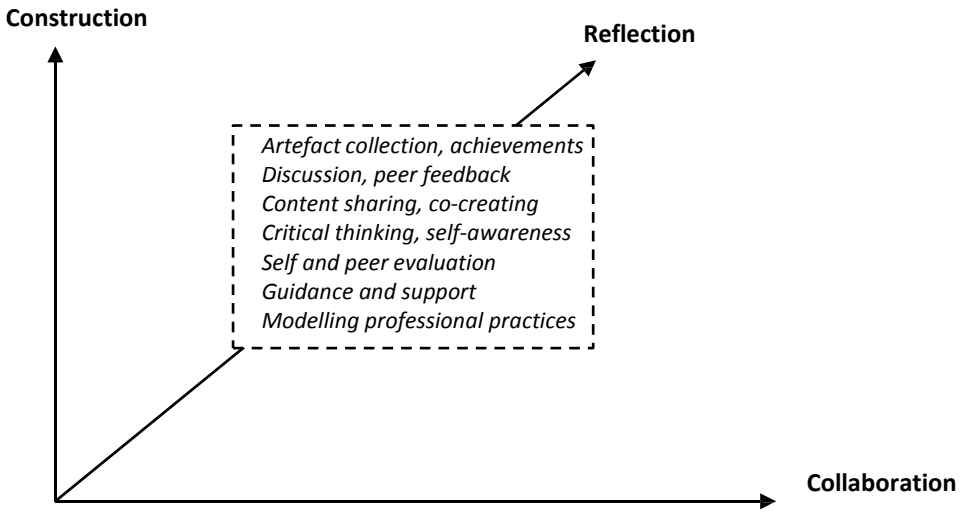

Figure 1. The three dimensions of e-portfolio learning process

Construction: This dimension projects a) planning, organization, workflow and development of student's accomplished work and b) the documentation of representative work samples (artefacts) that provide tangible evidence of student's knowledge and skills' development.

Reflection: It is students' critical thinking about their work material, achievements and learning. It helps students to construct a sense of their learning experience and developmental process.

Collaboration: Meaningful reflection is best facilitated by peer collaboration and mentoring within a learning community.

The three key elements (dimensions) of e-portfolios should not be considered in isolation, but rather through the complex relationships in the space they define. Any combination of two components ensures a deeper learning experience. However, when all the three components of an e-portfolio are activated, students have enhanced opportunities for self-directed and meaningful learning, and personal growth and development.

Summarising, the pedagogical affordances of e-portfolios, outlined in this section, determine their advantages as seen from the educator's point of view, e.g. the systematic storage and analysis of the digital artefacts incorporated. Student artefacts and achievements in e-portfolios are aggregated, searchable, reusable, transferable and sharable. In addition, by embodying Web 2.0 and social media functionalities, e-portfolios can strengthen and improve reflection in ways that help learners make meaning from their formal learning experiences, self-directed studies and job-related experiences. Current e-portfolio systems bind learning to problem solving, innovation, individual and group learning, collaboration, improvement and performance management, and professional development and growth. Overcoming the constraints of time and physical space, e-portfolios help individuals to receive guidance and inspiration of experts in their institution and around the world.

A conceptual framework for e-portfolio learning

From the analysis above, it is obvious that an e-portfolio is not a cumulative space for storing students' work or an individual repository of selected artefacts. It is more than a combination of a *process* (a series of activities) and a *product* (the end result of the e-portfolio process). Learners' *reflection* and *collaboration* are central to reaping the full advantages of learning portfolios. In addition, an e-portfolio includes evidence of standards and goals, self-direction and assessment. Rooting in the pedagogical principles of the social constructivism (Vygotsky, 1978), what differentiates e-portfolio from a digital-online collection is its organization around

- motivation, engagement and achievement
- structured and focused way of working through a process of planning, application, reflection, and attainment
- organizing and directing students' work according to specific criteria, standards, goals and development outcomes
- group working, peer feedback and *community building*
- student's assessment (tutor, peer and self)
- *reflective* and *collaborative creation* of content and, consequently, for collaborative knowledge construction
- extending learning *beyond the classroom boundaries*

- *blended learning* activities and collaborative activities that might not be possible in the classroom
- *personalised learning*, both individually and as a member of a community of practice.

Currently, e-portfolios are suggested as a mean of a wider strategy to embed learner-centred and reflective pedagogical philosophies in schools (Chang & Tseng, 2011; Meyer et al., 2010), universities (Lin, 2008; Wall et al., 2006) and personal development practices (Lygo-Baker & Hatzipanagos, 2012; Strudler & Wetzel, 2005). The use of e-portfolios as a reflective tool has its theoretical roots in ideas such as the *constructive alignment* proposed by Biggs (2003). The idea of this constructivist approach about learning is based on the notion that everything in a curriculum, including the assessment tasks and the instructional methods, should be aligned with the intended goals and learning outcomes. A student can reflect on how he is meeting or failing to meet these standards of competencies while the instructor can support his students by providing feedback and guidance.

From its technological perspective, an e-portfolio is usually a password protected system. After registration, the students can use the e-portfolio functionalities which are structured around the main dimensions (components) that characterize an e-portfolio as learning tool and process: information storage and management, communication, collaboration, assessment and development.

Helping tutors and teaches to conceptualize e-portfolio, as a reflective learning environment and develop positive attitudes towards integrating e-portfolios in their practice, appear to be a complex task (Peacock et al., 2010; Shepherd & Skrabut, 2011; Swan, 2009). In this article we propose an integrated framework of factors determining the structure of e-portfolios along four interrelated dimensions. Figure 2 shows the structure of an e-portfolio learning experience and the processes evolved therein. The multidimensional nature of this framework is influenced by the many *personal*, *technological, pedagogical* and *contextual factors* which are analytically discussed in the next of this section.

E-portfolios are expected to be used in practice as easily accessible collaborative learning environments acting as content composition systems, content information repositories, project implementation spaces, and online discussion and collaboration spaces. They should embody efficient tools for long term project or group activities, where a central community space is required for discussions, virtual meetings, and general course management. Interactivity tools allow dialogue and feedback within the portfolio space through comments, content sharing, and collaborative editing. A data management system allows collection of evaluation data and artefacts, and can produce reports aggregating quantitative data. Supporting personalization and creativity are also important technological features of an e-portfolio system.

Towards outlining a conceptual and pedagogical framework of e-portfolio based learning, we define five main components in relation to the dimensions above:

a) Instruction area: The instruction area includes a number of tools and features aiming to guide and support students' e-portfolio activities:

- description of learning goals
- curricular standards and criteria
- timeline and schedule description
- educational material and resources
- student assignments - examples of student work
- instructional and learning support
- guidance and technical support.

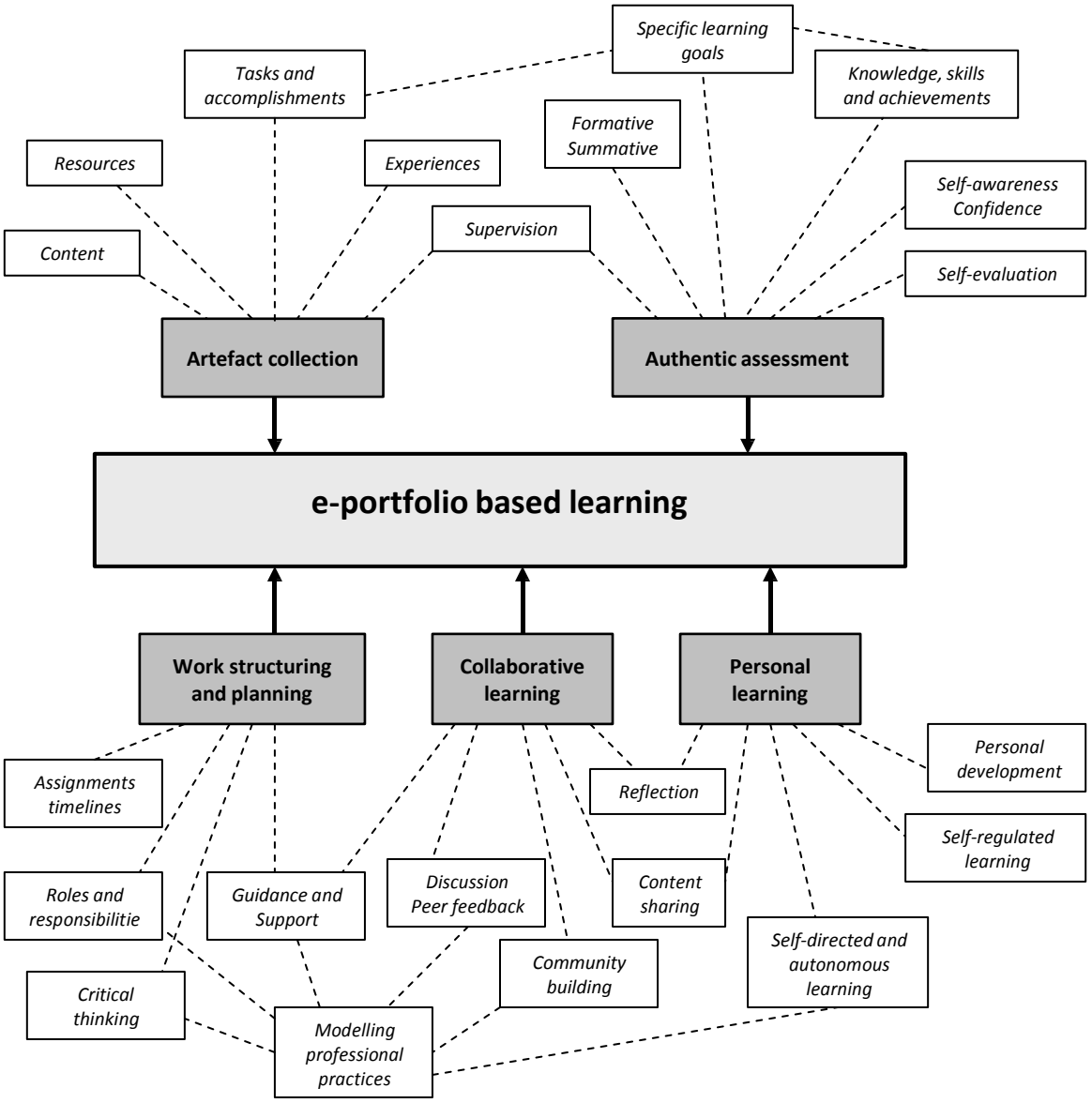

Figure 2. Conceptual and structural model for e-portfolio learning processes

b) Portfolio area: The portfolio area helps students to keep a track of all their entries and personal work, and to prepare them for submission to the assessment area. The students can use this area to implement various e-portfolio tasks and activities:

- to upload personal work (assignments, tasks, exercises, reports ets.)
- to keep a personal and group file area
- to collect content material
- to create content links and archives
- to write their project diary (e.g. in form of a blog)
- to plan project tasks and actions (e.g. in form of a wiki)
- to create a project report (in the end of the course).

c) Community area: A portfolio without peer interaction and reflection is just a multimedia presentation or an electronic repository. The community area gives an overview of members and the learner groups that participate in the course or the study programme. Tutor and student information-profiles (name, contact information etc.) should be easily accessible

from this area. Registered users can create new project groups or join existing groups by request. Additionally, the community area features various tools for reflection, collaboration, project and knowledge management, e.g. discussion forum, a community blog, a wiki, a shared file repository etc.

d) Personal learning area: An e-portfolio is also a personal learning management system aggregating a number of functionalities that

- support students' engagement, creativity and collaborative learning
- facilitate formative and reflective feedback
- promote students' critical thinking, responsibly and self-awareness
- enhance personal learning and development.

e) Assessment area: The assessment area enables the instructor to develop an authentic assessment space for his students, with both formative and summative features, in order to meet the achievements that have been performed in the context of the course or the educational programme. In addition, peer- and self-assessment and evaluation tools add value and enhance student reflection, personal development and learning. Rubrics (criteria or rating scales) can be used by the instructor to track students' performance and assess their work; rubrics can also be used to inform students of the course expectations.

Types of e-portfolio tools

E-portfolios can be created using a variety of tools, both conventional and specific Web tools. Currently, there are five main categories of efficient e-portfolio tools and environments applicable in educational practice.

Learning Management Systems (LMS): A LMS is an application for the administration, documentation and delivery of courses and educational programs in both online and blended form. An LMS operates as a platform handling all aspects of the learning process, e.g. delivering and managing instructional content, identifying, tracking and assessing students' progress towards meeting specific learning goals, reporting and supervising the learning process of a student, a class and the institution as a whole, collecting data for analysis and presentation. Important dimensions of LMS that support e-portfolio operation are content delivery, personalization and reusability, student self-direction, learning workflow, managing of resources, collaborative learning, on-line assessment etc. Popular LMS like Blackboard, Moodle, Sakai etc. incorporate e-portfolio features. However, most of them are structured around instructors' choices and they are restricted to support, mainly, course directed e-portfolios.

Content Management Systems (CMS): Content Management Systems are software systems providing website authoring capabilities (e.g. publishing, editing, modifying and sharing content) and tools for managing workflow, collaboration, multiple author editing and administration. Robust CMS offer users the ability to manage and implement e-portfolio initiatives because of their features, e.g. access control, automated templates, scalable expansion, scalable feature sets, managing of workflow, document management, collaboration, delegation, content syndication, versioning, and other features important for e-portfolio operation. Popular open Source systems like Drupal (Metscher, Strehl & Sporer, 2010) and Plone can effectively support e-portfolio based learning initiatives.

Web 2.0 tools: Because of their participatory features, Web 2.0 applications like blogs, wikis, collaborative editing tools etc., are very effective toward supporting e-portfolio based learning. They offer enhanced opportunities for communication, reflection, active and self-directed learning, co-creation of content, sharing and resources, collaborative learning, and

ubiquitous learning by extending learning spaces beyond the walls of the classroom and bridging learning and instruction spaces across school, home, and the wider community (Jimoyiannis, 2010). Popular Web 2.0 tools are WordPress, WikiSpaces, Mediawiki, PBWiki, GoogleDocs, Zoho etc.

e-portofolio Management Systems: Most of them are open source systems which were designed essentially as learning portfolios. Currently, the most popular e-portfolio systems are Elgg, Mahara and Pearl. Their design includes content management tools, thus allowing uploading of files which can be incorporated as artefacts in internal blogs or views and be shared with other individuals, groups or communities. The communication tools incorporated in e-portfolio systems support dialogue and provide an environment for collaboration, peer and self assessment, and self-regulation. In addition, they support the notion of sustainable community, lifelong learning and personal development.

Hosted e-portofolio services: These are hosted e-portfolio systems that support full e-portfolio functionalities and activities; no institution server is required. However, they have limited access to data management and reporting systems and, consequently, limited abilities to investigate e-portfolio operation aspects (students' engagement and personal activities, content creation, group activities etc.). Currently, the most popular e-portfolio services are:

- Digication (http://www.digication.com)
- Epsilen (http://corp.epsilen.com)
- iWebfolio (https://www.iwebfolio.com)
- PebblePad (http://www.pebblepad.co.uk).

Implementing e-portfolio in educational settings

Case Study 1: Sakai as a course portfolio

The first case study presents a course e-portfolio designed to support blended learning activities in a 7th semester elective course, entitled *"e-learning and Distance Learning"* at the Department of Social and Educational Policy, University of Peloponnese, in Greece. It was implemented in the autumn term of 2010. The main goal of this course was the students to examine and learn about the issues, trends, perspectives, current models and technologies used in e-learning and distance learning programmes. The module involved class sessions and learning tasks from distance which focused on peer learning, dialogue, feedback and reflection. 12 students attended the course while Sakai used as a course portfolio system. It was integrated into the course, in a way complementary to face to face sessions, with the aim to operate as both a learning management system and an e-portfolio system.

Sakai is an open architecture system which, beyond LMS features and the abilities to create on-line courses, incorporates a variety of communication, collaboration and search functionalities. There are two types of functions included, e.g. the *project* and the *portfolio* tool. These tools support data collection and processing, assignment area, learning trajectory description, discussion forum, personal workspace, personal pages-sites, podcasts etc., offering thus an efficient e-portfolio environment. Sakai was transferred to Greek language and was parameterized to meet the needs and objectives of blended courses. Figure 3 presents a screenshot of the system showing examples of students' activities in the discussion forum.

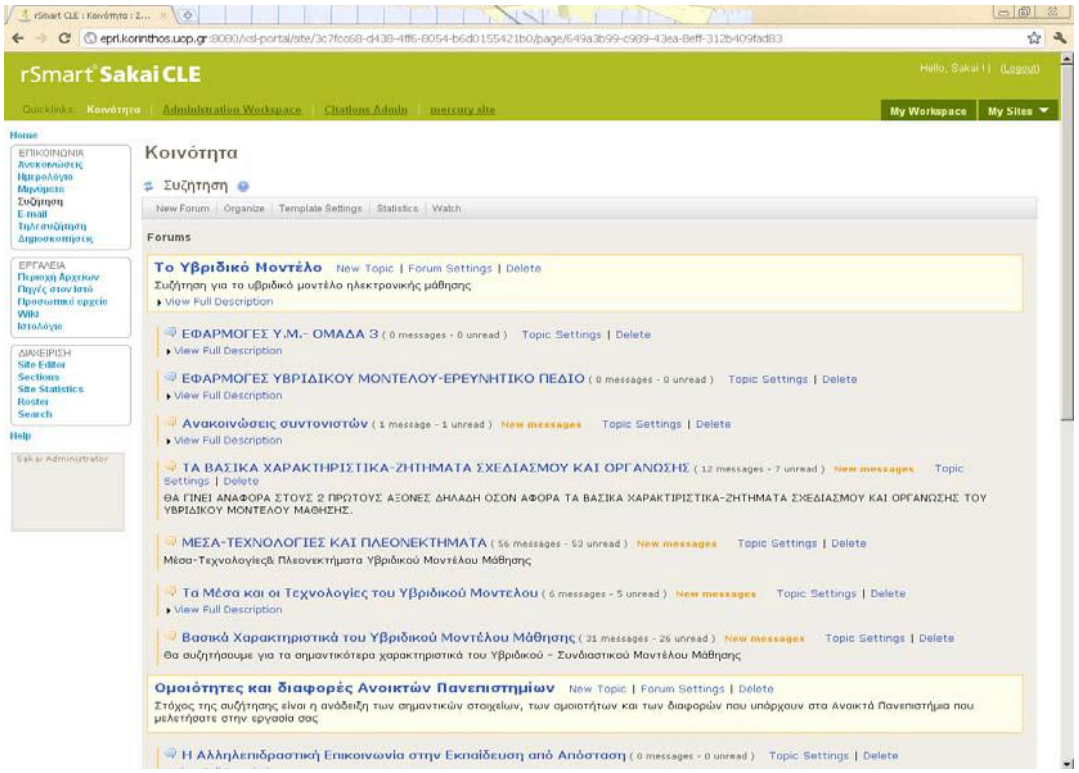

Figure 3. A course e-portfolio supported by Sakai

In this particular module, Sakai was used as a course e-portfolio which was designed as a dynamic learning environment to support students' collaboration and development rather than as an evaluation tool. The system provided course information, access to content material and knowledge resources while promoted feedback by peers and the instructor. Students were asked to upload in their personal workspace content material related to assignments, to incorporate relevant literature review, to discuss on critical issues and themes emerged in both classroom sessions and on-line activities, to collect evidence of competencies and skills, to record written assignments and personal achievements and reflect on them.

Case Study 2: Elgg as working portfolio

The second case study describes how e-portfolios can be used to support teacher working groups for the implementation of developmental projects in education. Elgg was used as a showcase and working portfolio in the context of a national project aiming at the development of the National ICT Curriculum for compulsory education (primary and lower secondary, K-9). The main project activities lasted for seven months (December 2010 – June 2011). The author was a member of the National Curriculum Board and the coordinator of the ICT Curriculum Board. 18 scientists participated in the project activities: 2 university professors, 3 ICT teacher consultants, 4 computer science teachers (secondary education), 5 primary ICT proficient teachers, and 2 pre-school educators.

Elgg is an open source platform that integrates Web 2.0 features and provides the necessary social networking functionalities to support personal and group work in educational and developmental projects. The system combines the key features of an LMS (like Moodle, Sakai, Claroline etc.) and the features of social networking applications that can create a powerful internal collaborative platform (e.g. a secure networked intranet) to build various types of e-portfolios. Elgg provides personal tools available to the users, e.g. personal file

repository (with podcasting capabilities), personal blog, online profile, RSS reader etc. Additionally, user content can be tagged with keywords, in order that members are able to connect with peers having similar interests and create their own personal learning network. Each personal item, artefact, blog post, or uploaded file can be assigned its own access restrictions (e.g. to be readable by an individual or a particular group or fully public). In addition, Elgg supports group functionalities within the community of participants by creating and managing groups of friends, sharing information, files and content material, operating at various access levels (e.g. processing, reading) etc.

The present instance of Elgg was transferred in Greek and parameterized to cover the needs of creating a professional community and supporting e-portfolio objectives. It was set up, with a series of plug-ins, in a separate server at the Department of Social and Educational Policy, University of Peloponnese, in Greece. Figure 4 shows a screenshot of the platform displaying teachers' project activities therein. The project members were asked to use Elgg as the principal communication, discussion, collaboration, selection, storage and co-creation environment. They were asked to share files, information, recourses and ideas in order to collaboratively define learning goals and objectives, create curriculum materials, design learning activities and tasks, and propose relevant educational material to be included in the K-9 National ICT Curriculum. Peer feedback, discussion, criticism, extending and synthesis of ideas were the key activities effectively supported by the Elgg portfolio system.

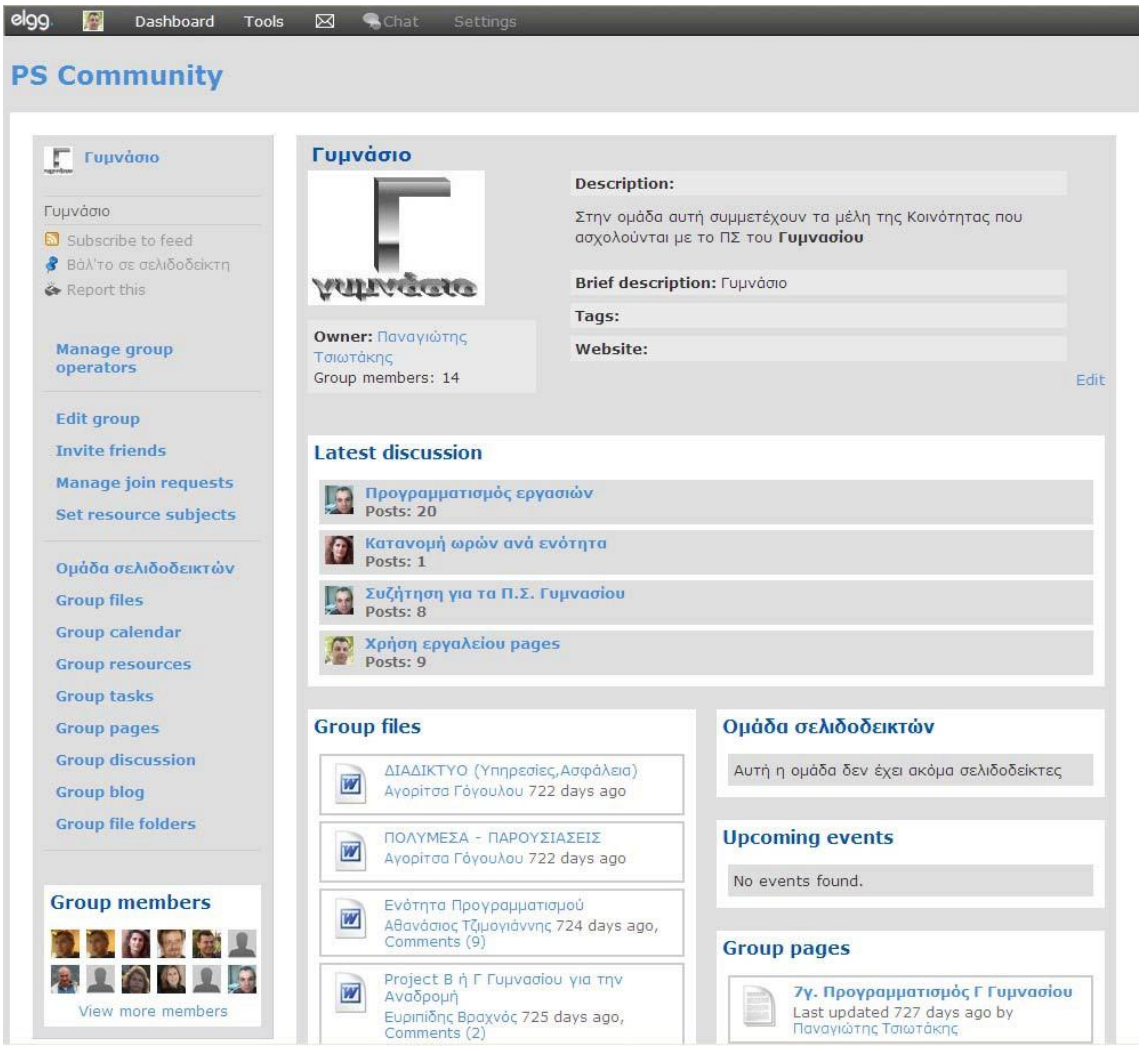

Figure 4. A working portfolio supported by Elgg

Case Study 3: Mahara as an assessment portfolio

The third case study describes how e-portfolios can be conceptualized within the area of teacher professional development and assessment. Mahara was used as a showcase and evaluation portfolio in a teacher development programme about the integration of ICT in science and math classrooms. The program was conducted in the context of a national project, funded by Greek and EU authorities, with the aim to prepare proficient science and mathematics teachers to gain sound pedagogical and technological knowledge, as well as learning design knowledge and skills, towards the integration of ICT in classroom practice. The participants were asked to organize and document their achievements, knowledge and skills in order to meet the certification requirements, as teacher trainers, set by the programme. The programme was implemented at the Department of Social and Educational Policy, University of Peloponnese, under the co-ordination of the author. The course sessions lasted 380 hours in total, divided into five-hour sessions, which were spread from May 2011 to February 2012.

Mahara was designed essentially as a learning portfolio owned by the learner; it allows learners to upload multimedia files which can be incorporated as artefacts in any internal page or blog while they can be shared with other individuals, groups or communities. Accessibility, ownership, interoperability and transferability are the main features justifying the adoption of Mahara as a lifelong learning and development tool. The collaborative and communication tools included support peer discussion and provide an efficient environment which promotes collaboration, self-regulation, peer and self assessment, and supports personal development.

Figure 5 presents a screenshot of the Mahara e-portfolio environment showing the artefact collection (personal blog, resources, lesson plans, educational scenarios, reports, articles) as displayed by a science teacher. In order to meat the needs and the objectives of this particular project, the system was parameterized by the Computer Technology Institute, which is responsible for supporting and organizing the electronic infrastructure of the Greek educational system, available for schools, students and teachers.

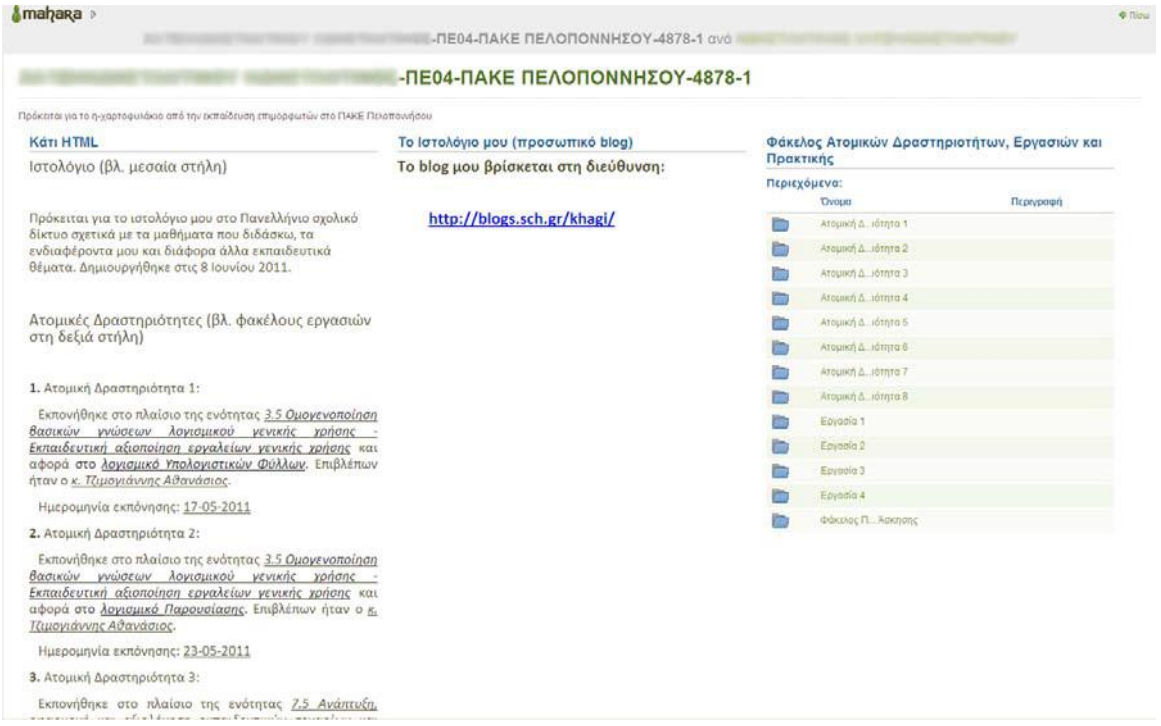

Figure 5. A teacher evaluation portfolio supported by Mahara

The teachers were asked to upload in their personal area various artefacts related to their professional practice (e.g. relevant literature review, resources and educational material, lesson plans and scenarios, reports and experiences form classroom practice, links to a personal site or blog etc.) and to discuss on critical pedagogical and learning design issues emerged in the face to face sessions and in their individual classroom practice. Feedback from the majority of the participants indicated that e-portfolio was an important experience regarding the outcomes of the programme and, in particular, their professional development and teaching practice. Portfolio activities fostered teachers' continuing professional development through reflecting on learning artefacts, promoting critical thinking, peer discussion and feedback on learning and teaching with ICT.

Case Study 4: Wikis as e-portfolios

Because of their affordances, wikis are gaining educational and pedagogical interest as a powerful tool offering to the students increasing opportunities (Roussinos & Jimoyiannis, 2011) for a) engagement, collaboration, and community building, b) learning to work in groups and create content collaboratively, c) peer feedback and collaborative knowledge construction, d) reflective learning and self-directed learning, e) peer-assessment and self-assessment of their progress, and f) supporting blended learning activities by extending learning beyond the classroom boundaries.

In a specific learning context, a wiki can be used as an e-portfolio to support students collecting and presenting their personal work and to illustrate individual learning and development processes (Schaffert et al., 2006). The idea behind wiki-portfolios is to give access to a simple web publishing system so that any student can easily participate and publish his work. Instructors can easily access a wiki-portfolio to guide and support students' work and assess their progress and achievements.

The fourth case study presented here, concerns a wiki-portfolio activity under the title e-mathisi2011 (in Greek, mathisi means learning). It was implemented, in the autumn term of 2011, in the context of a master's degree course entitled *"e-learning"*, at the Department of Social and Educational Policy, University of Peloponnese. 16 postgraduate students attending the course were randomly assigned to four groups. They were required to actively participate in and collaboratively create a complete wiki to supplement course content material and resources. It was an obligatory assignment, lasted for four months (full semester). Each group worked on a separate wiki topic, namely "Learning theories and ICT", "Web 2.0 and Education 2.0", "Blended learning", "Technological Pedagogical Content Knowledge (TPACK) model". Wikispaces was the hosting wiki environment (Figure 6).

The students in each group were individually responsible for planning, designing, authoring, discussing, modifying, conceptualizing, and criticizing their group wiki pages. They were also encouraged to use the wiki discussion space in order to comment peer work, to debate on controversial topics and conceptual difficulties, to decide about the content and the form of the basic wiki pages of their topic, to help each other resolving both technical problems and learning bariers etc. The instructor (author) and his assistant provided guidelines related to the wiki-portfolio assignment, comments about the content to be included, the structure of the wiki, the need for connecting material with classroom presentations and discussions, prompts for student collaboration etc., through both the wiki and classroom sessions. Student individual contribution, content sharing and co-creation, communication and collaboration displayed in their group space were evaluated and graded; the wiki assignment contributed to the course mark at 30%.

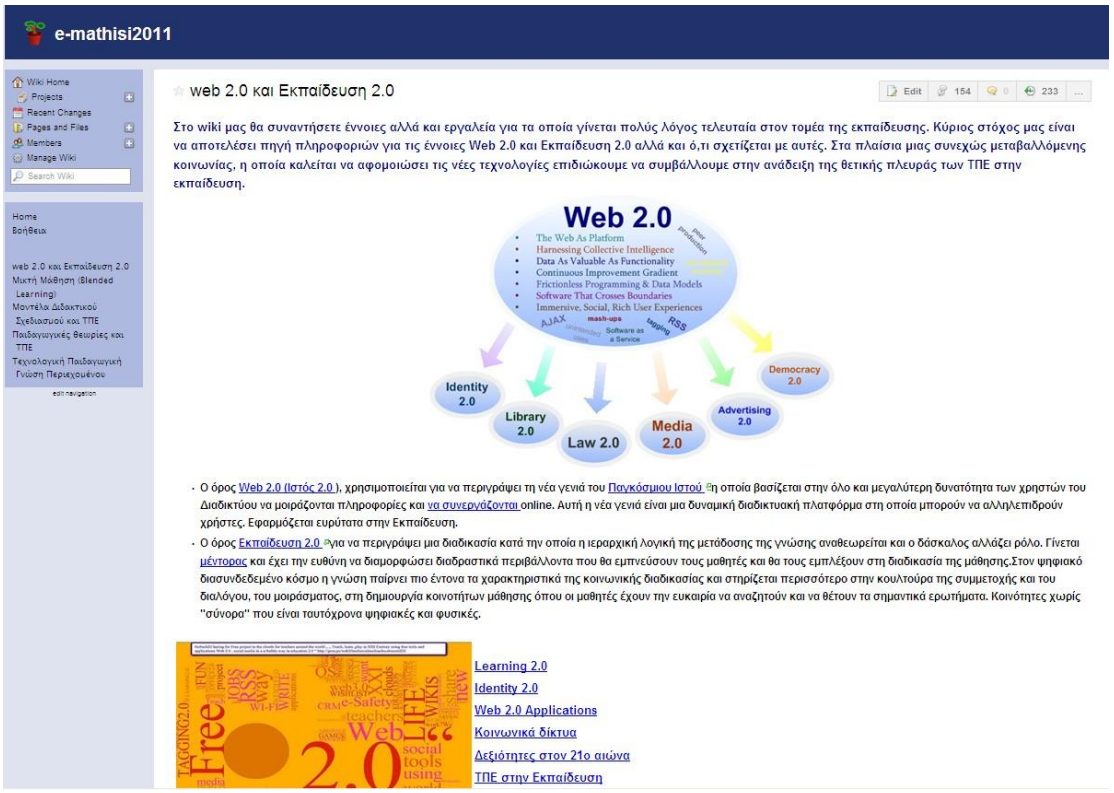

Figure 6. A screenshot of the wiki-portfolio

Despite that students had no previous experience of wiki writing and publishing, they demonstrated enhanced interest for their group wiki-portfolio and motivation to participate in this assignment (e.g. sharing resources, interchanging ideas, discussing significant topics, co-creating content etc.). A total of 135 wiki pages were collaboratively constructed. There were recorded 530 page-edits and 1466 student comment posts, which are strong indicators of students' collaboration to construct and co-create their wiki content. Table 1 presents students' wiki activities regarding the four topics assigned.

Feedback from students confirms that they enjoyed the experience of wiki-portfolio and they evaluated positively this particular assignment. They acquired personal writing and collaboration skills and wiki editing and publishing skills; they collaborated and received feedback and support from peers, which helped them to conceptualise and understand the particular topics in a constructive way. Collaboration with other students and the creation of their own content, related to the topics they studied in a meaningful connection to classroom teaching, were motivating factors for the students. An important issue was also that the wiki content was updated on a regular basis, so there was always new material available for them to read. In addition, the wiki served as a flexible source of information and the students used it for further study and for their personal preparation for the term exams.

Table 1. Students' wiki activities (e-mathisi2011)

Wiki topic	Wiki pages	Page-edits	Comment posts
Web 2.0 and Education 2.0	45	178	581
Blended Learning	39	179	428
Learning theories and ICT	34	71	162
TPACK model	17	102	295
Total	135	530	1466

Case Study 5: Blogs as e-portfolios

In the last years, educational blogs are gaining in popularity in schools and higher education institutions as collaborative and active learning tools. Literature review by Angelaina & Jimoyiannis (2011) indicated that the inherent participatory and interactive affordances of blogs a) enable students to exchange ideas and share experiences and content, b) promote individual as well as group reflection on student work and learning experiences, c) offer enhanced opportunities for collaborative content creation and collaborative knowledge construction, d) support authentic learning tasks and peer evaluation, and e) extend learning beyond the classroom boundaries.

Blogs constitute a friendly and easy to use tool supporting e-portfolio activities, especially when teachers and students are not very competent with ICT and complex Web platforms. There is extended research evidence indicating the efficacy of blogs as e-portfolio environments in educational practice (Carroll, Calvo & Markauskaite, 2006; Dippold, 2009; Farmer et al., 2008; Tzeng & Chen, 2012). Students post to the personal, group or class blog their individual work, writing assignments, short articles, exercises etc. The instructor is able to monitor students' progress and development, to offer feedback and support them to overcome cognitive difficulties and barriers, and, finally, to assess student contributions to the blog. In addition, students can share their blog articles with classroom peers and receive their commentaries in the comment area.

The last case study presented here concerns a group blogging project which was designed as an obligatory assignment in the context of a second semester course, entitled "Internet Services and Applications", at the Department of Social and Educational Policy, University of Peloponnese. It was implemented for a period of eight weeks (April to June 2011). 48 students were attending the course while 44 of them were actively engaged into the blog assignment.

The students were randomly assigned to 10 groups of between four and five. They were asked to collaboratively create their group blog with content regarding "Internet Safety" appropriate to inform peers and younger people (e.g. teenagers). The students were individually responsible for their own group blog. One student per blog was assigned as administrator. The students in each group discussed on planning and designing issues before structuring their blogs. The group blogs were created and hosted by a WordPress multi-blogging server, which was set up at the Department of Social and Educational Policy. Figure 7 presents the home page of a typical group blog. Separate blog pages, e.g. task description, group presentation, links to resources, recent articles, archives, tags etc., were the common pages in the various blogs.

Students were required to be active bloggers by writing articles of 300-400 words and posting commentaries on a regular basis. They were asked to reflect upon peer contributions and course content through discussing, criticizing, modifying and expanding the ideas and the themes emerged on their group blog. They were also asked to interact with peers and participate in other group blogs. Guidelines were given to the students in order to focus their blogging actions on peer communication, exchanging ideas, debating and synthesis of ideas, sharing on-line resources and content material, authoring collaboratively and avoiding plagiarism. The students were informed that their personal contribution, collaboration and the overall outcome of their group blog will be evaluated and graded to the course mark (contribution coefficient 30%).

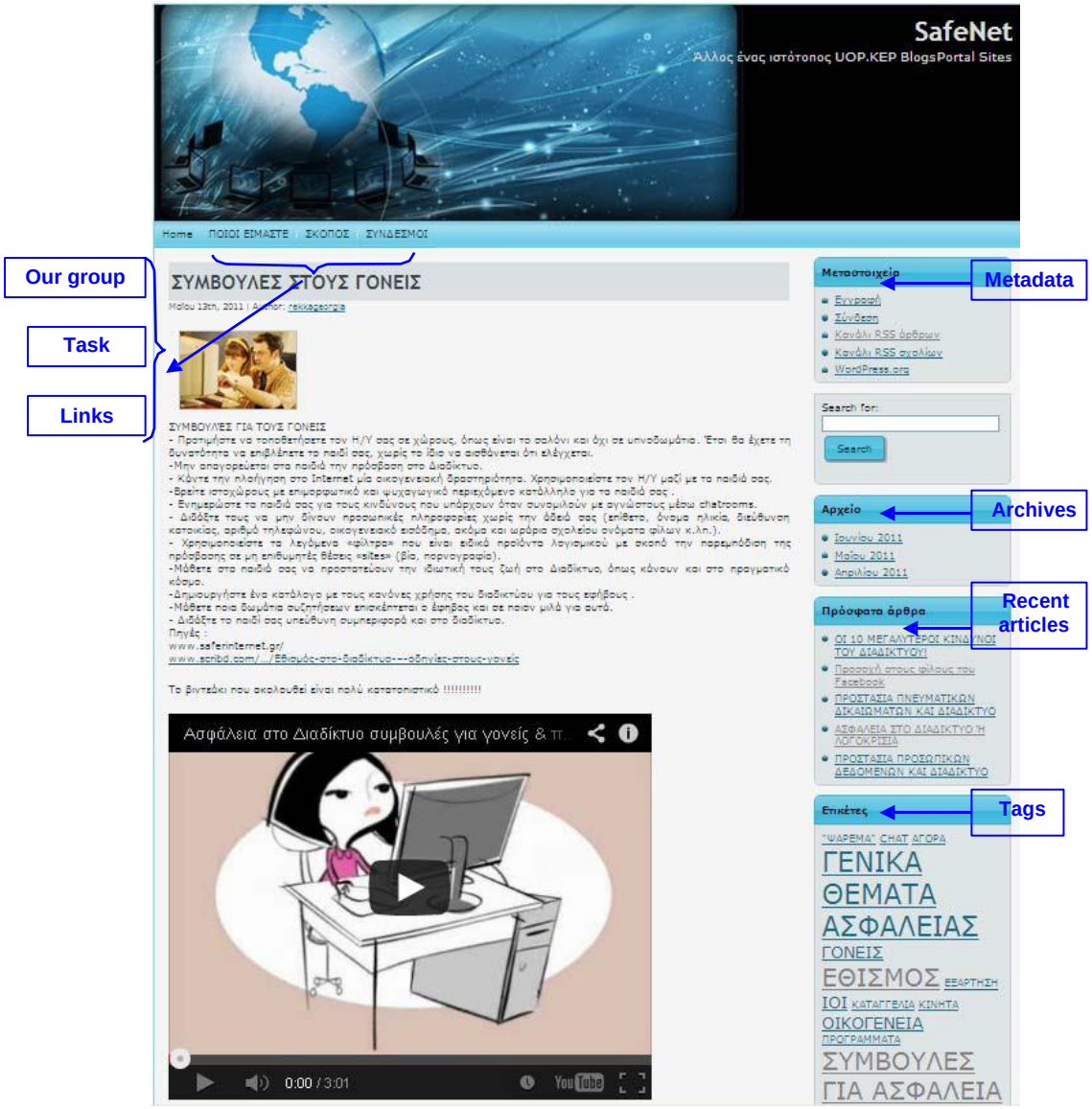

Figure 7. A screenshot of a group blog

The participated students, though familiar with computers and the Web, had no previous experience with educational blogs and blogging, in general. However, the majority of the students demonstrated enhanced interest for the assignment and they actively participated in. A total of 1214 publications were uploaded during the blogging period. There were recorded 200 group articles, 15 group pages (accessible only by group members), and 999 comment posts; 472 of them were commentaries from group peers and 527 from non-group members.

Analysis of both, the students' contributions and the content of the postings they uploaded, showed that blogs can be effectively introduced in higher education as both personal and collaborative learning environments (Jimoyiannis, Tsiotakis & Roussinos, 2012). In particular, the analysis of the highly cohesive groups suggested that students in blog communities have enhanced opportunities to operate at higher cognitive levels by improving critical thinking, individual reflection, peer interaction and collaboration skills.

In conclusion, this case study showed that educational blogs used as e-portfolios, can support online learning groups where students have enhanced opportunities to interact and

collaborate, to share content and ideas, to meaningfully connect classroom instruction and personal work, and to construct knowledge within a community of inquiry.

Discussion

In searching the educational affordances of e-portfolios, this paper reported on the development of a conceptual and structural model for e-portfolio learning. The model outlined treats e-portfolios not as a simple or an 'add-on' technology but in an integrated pedagogical framework rooted in the principles of *social constructivism*, *reflective learning* and *collaborative learning*. The paper addressed a detailed review of both theoretical foundations and empirical implementation of e-portfolios in higher education and professional development programmes.

The case studies presented revealed the educational potential of moving from the traditional view of the portfolio (as a collection of personal work selected and organized by the student) to a dynamic learning environment that influences students' participation, self-directed learning, peer feedback, content and ideas sharing, collaborative construction of artefacts, and authentic assessment. Feedback from the participants indicated that e-portfolio activities were an important experience for the majority of them and had a positive impact on their formal learning and personal development.

In this paper, e-portfolios have been proposed as an integrated platform for instruction, learning and assessment, which reflects individual student work and growth within a community of learning. If they can be deployed effectively across classroom and institution settings, tutors, students, schools and universities need to develop clear objectives and strategies around the *participatory*, *collective, reflective, collaborative*, *co-constructive* and *assessment aspects* of e-portfolios. Supporting current educational policy suggestions (AeP, 2010), the proposed structural model could support the design of e-portfolio learning harnessing the organizational and pedagogical features of Web 2.0 tools in practice to support students' reflective learning and meaningful understanding.

The construction of an e-portfolio is, therefore, an effective form of professional development and cultivating lifelong learning. However, despite their potential advantages, the effective implementation of learner-centred learning using multi-tooled e-portfolios poses major challenges to learners, educators and institutions. These include resource overload, assessment difficulty, complicated systems integration, and privacy and professional concerns (Shepherd & Skrabut, 2011). The construction of learning portfolios with an explicit focus on learning brings course-participants into the centre. As they become more aware of their own learning, through a process of reflection and peer feedback, they are able to implement self-directed and collaborative learning activities.

Undoubtedly, there are still many issues open to clarify, once the nature of e-portfolios has been conceptualized by the educators, schools and higher education institutions. For example

- What is the purpose of an e-portfolio in practice? Where is the balance between e-portfolio usage as assessment and as instruction/learning tool?
- What are the links to curriculum and instruction? How could we best assess and evaluate students' learning outcomes in e-portfolios?
- How could we promote and enhance students' participation in e-portfolios? How could we best prepare and support them to be responsible and reflective learners in e-portfolios?

- How could we prepare teachers to conceptualize both the pedagogical and the organizational aspects of e-portfolios? How they can effectively implement e-portfolios as a personal learning environment and an assessment tool?

The questions above could address, among other issues, future research towards responding to the new needs for researching pedagogy arising around e-portfolios.

Implications for practice

This paper debated on e-portfolios as appropriate tools that could be integrated in educational practice, in higher education institutions and primary and secondary schools. It is expected that, under well-designed e-portfolio implementations, learners are becoming empowered, motivated, more reflective and interactive practitioners in authentic learning experiences. Focusing on authentic contexts, technologies as mediating tools have the potential to transform and enrich learning experiences. However, for this to happen it is imperative for tutors and learning designers to carefully plan and facilitate learning tasks that promote both authentic and reflective learning.

A suitable design and organization of e-portfolios should aim to effectively support collaborative learning and building a community of inquiry. Therefore, e-portfolios should not be used as a repository of students' collected work but they should be purposefully embedded into the curriculum (with specific goals, achievements and organization). In addition, they should involve students in self-reflection, employ clear evaluation standards and criteria, include guidelines for work construction, managing and organization, examine students functioning in real-life situations, provide continuous feedback from both peers and the tutor, help learners to articulate and present their skills and achievements and encourage student self-awareness, confidence and responsibility for learning.

According to the pedagogical framework proposed in this paper, good practices for the implementation of e-portfolios in educational settings could be described by the following principles:

- Assign meaningful and authentic learning activities in e-portfolios
- Provide explicit information regarding the learning objectives of the particular e-portfolio
- Organise the conceptual outline of the e-portfolio in a meaningful way providing key terms, tools, good examples and adequate time for practice
- Provide the necessary technical assistance to promote students' participation
- Include detailed instructions as a separate page (FAQ)
- Define clearly the students' roles, activities, individual and group work
- Encourage reflection and collaboration among students
- Promote discussion and ideas sharing
- Offer scaffolding and prompt feedback to the students' contributions
- Make clear that students' collaboration and content contribution will be a part of their assessment
- Provide complete criteria and standards for student assessment
- Create a culture of trust and collaboration among students
- Remind students for deadlines and schedules
- Help students to make individual and group work visible and easily accessible
- Embed e-portfolios into the curriculum and the educational context of the institution in a sustainable way.

Conclusion

In conclusion, this article presented a conceptual and structural model for e-portfolio learning with the ambition to contribute to the development of an integrated framework conceptualizing a) the affordances and the pedagogical value of e-portfolios, and b) guiding the design of effective e-portfolio implementations in practice. Undoubtedly, constructive criticism and debate are welcome and beneficial to identify potential problems and weaknesses in our approach. Further research is required to determine whether and how e-portfolio design issues, student characteristics, instructors' role and supportive actions, assessment and evaluation, the discipline area, the wider educational context etc., influence the effectiveness of e-portfolios in educational practice.

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