MANAGEMENT OF COURSE PORTFOLIOS THROUGH A SMART E-PORTFOLIO SYSTEM

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Abstract

Course portfolio is a set of documents that focuses on the unfolding of a single course, from conception to results. It is an attempt to document one’s teaching practices in a particular course over a period of time. It is about process, about evidence relating to teaching, learning, and development. Performing the processes of preparing course portfolio is part of lectures’ duties. Theses processes include: collecting, storing, accessing and retrieving. All of these processes are normally done manually by lecturers. These manual processes lead the following problems emerged in the workplace: 1) storage problem, (2) retrieving information problem, (3) paper organization, (4) time spent preparing and processing paperwork, and (5) difficulty in evaluating the level of performance of current course.

To overcome the above problems, Smart Electronic Portfolio (SEP) web-based system has been developed. The system has three stakeholders who they themselves are users to the systems: the lecturers, the administrative staffs and the students. For the lecturers, the system enables them to create and to manage course portfolio electronically. The system automates all the storing, accessing and updating of the course portfolio. In addition, the system has the capability that allows users to share and exchange knowledge about the courses. The system also allows lecturers to receive assignment from students online. For the administrative staff, the system provides the ability to audit and track lecturers’ course portfolios. The system also supports administrative users with a data mining tools to analyze and to evaluate the course portfolio. Finally for the students, the system enables them to submit their assignments online. The system enables students to create their curriculum vitae online.
This study employs qualitative research method that includes observation, document analysis and interviews for data collection process. The findings of the data analysis are use as system functions requirements in developing of SEP.
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<td>ASP</td>
<td>Active Server Page</td>
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<td>COMPASS</td>
<td>Computer Science Programme Assessment</td>
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<td>FCSIT</td>
<td>Faculty of Computer Science and Information Technology</td>
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<td>HTML</td>
<td>Hyper Text Markup Language</td>
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<td>Hypertext Preprocessor</td>
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<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
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<td>IIS</td>
<td>Internet Information Service</td>
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<td>SEP</td>
<td>Smart Electronic Portfolio</td>
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<td>PHEI</td>
<td>Public Higher Education Institution</td>
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<td>QMEC</td>
<td>Quality Management and Enhancement Centre</td>
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<td>QMS</td>
<td>Quality Management System</td>
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<td>SQL</td>
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<td>Web-based Educational Assessment System</td>
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Chapter 1: Introduction

In this first chapter, - the basis for the research area - is established. An introduction and a general background are provided to describe the areas in which the study was conducted, as well as justify the significance of the specific research performed. Finally, the research problem – has been clearly stated, followed by the outline of the thesis.

1.1 Background

The use of digital, electronic or web portfolios is significantly increasing in higher education. During a current issues round table discussion at EDUCAUSE 2004, John Ittelson had stated that approximately 70% of higher educational institutions were implementing or currently using some form of electronic portfolios (Ittelson 2004).

According to the American Association of Higher Education (2001), portfolios have a broad application in a variety of contexts for the collection of meaningful evidence about learning outcomes that can enhance the effectiveness of student assessment programmes. Popper (2005) reported that portfolios can be used to assess learning-outcome achievements, as well as to diagnose curriculum deficiencies that require improvement. He explained that portfolios should include a variety of samples of student work so that learners and educators have ample opportunity to assess learning mastery.
Helen Barrett has published numerous papers over the past decade on the uses of electronic portfolios in education, explained that electronic portfolios, due to their dynamic nature, were able to illustrate relationships by demonstrating how student learning and achievements related to learning goals, and the ability of a programme to effectively communicate these goals to learners (Barrett 2000).

According to Batson (2002), such uses in higher education have approached a critical mass as electronic saturation on campuses is reached:

“We seem to be beginning a new wave of technology development in higher education. Freeing student work from paper and making it organised, searchable and transportable, opens enormous possibilities for re-thinking the whole curricula: the evaluation of faculty, assessment of programmes, certification of student work, and how accreditation works. In short, e-Portfolios might be the biggest thing in technology innovation on campus. Electronic portfolios have a greater potential to alter higher education at its very core than any other technology application we’ve known thus far”.

1.2 Electronic Course Portfolio

Electronic course portfolios are gaining prominence as an effective means of recording and/or sharing work. Members of the American Association for Higher Education’s (AAHE) Course Portfolio Working Group have created and shared examples in a variety of disciplines, including Biology, English and Nursing (Hutchings 1998). These examples have provided the lecturers, teachers and their colleagues with opportunities to
discuss scholarly and pedagogical dimensions of their teaching. They have provided evidence of the thinking that goes on behind the teaching and offered what Parker Palmer calls opportunities for “good talk about good teaching” (Palmer 1993). Finally, they have helped to demonstrate the kinds of learning that occurs in the classes in question, which, in most instances, created a culture of teaching and learning, both within and across departments and institutions.

1.2.1 Definition of Course Portfolio

Course portfolio is well known as a method for advancing teaching practices and improving student learning. According to Hutchings (1998), course portfolio is a set of documents that “focuses on the unfolding of a single course, from conception to results.” It is an attempt to document one’s teaching practices in a particular course over a period of time. It is about process, about evidence relating to teaching, learning and development. And because it looks to the future (in terms of revisions of the course), as well as to the present and past, it may also be about what “might be”.

Course portfolios prevent the loss of effective teaching techniques, thus providing the means for all instructors to continually improve existing curriculum. Course portfolios will enable most instructors to get a head start, especially those who are new to campus, those who are teaching for the first time, and/or those who receive late assignments and have little time to prepare (Stewart 2004).
1.2.2 Contents of Course Portfolio

William Cerbin (1994), a pioneer in the development of the course portfolio, proposes that it consists of four major parts: a teaching statement, an analysis of student learning, an analysis of student feedback, and a course summary. Others, such as Chein (1998), who states that the portfolio has to “tell a story of the course” and Hutchings (1998) notes that the portfolio has three components: documenting course design, enactment and student learning.

Most faculties which produce a course portfolio choose a design which suits their discipline, course and mode of reflection. The key components of the portfolio include: (1) teaching philosophy; (2) course design and objectives; (3) documentation/artefacts; and (4) assessment of the course. A few examples of artefacts that Hutchings (1998) cites include: handouts that relate to key assignments; reports from student group work, examinations or quizzes, readings, and study guides.

1.2.3 Course portfolio stakeholders

The definition of a stakeholder has been proposed by Freeman (1984) as follows: “A stakeholder in an organisation is (by definition) any group or individual who can affect or is affected by the achievement of the Organisation’s objectives”. With regards to course portfolio, there are two categories of stakeholders: internal and external. The internal stakeholders refer to university, faculty administration, lecturers and student. These group
of stakeholder are directly affected course portfolio. On the other hand, external stakeholders refer to industry which have indirect influence in course portfolio.

### 1.3 Research Problems

Course portfolio is a document evidence of a teaching, learning and development process. Process means a series of activities or methods to accomplish the objective, and can be defined as one or more steps or activities (Kim, Choi & Jung 2007). Performing the processes of preparing a course portfolio is part of a lecturer’s duty. These processes include collecting, storing, accessing and retrieving. All these processes are normally done manually by the lecturers. These manual processes lead to the emergence of the following problems at the workplace:

a. Storage problem: Dozens of file cabinets are required to keep these course portfolios;

b. Information retrieval problem: Cabinets are full of files. Not only does it take days to locate documents, sometimes certain papers cannot be found at all.

c. Paper disorganization often requires the faculty to request for duplication of paperwork.

d. Time spent preparing and processing paperwork such as collecting assignment samples and constructing lesson plans can also take a lot of the lectures’ time, and divert them from their main tasks i.e., teaching students.

e. Difficulty in analysing and evaluating the performance of current courses compared to the previous ones due to the availability of huge historical data.
1.4 Research Objectives

The overall objectives of this research are to:

1. Understand the present situation regarding the use of course portfolios in the Faculty of Computer Science and Information Technology (FCSIT), University Malaya;

2. Identify the processes involved in preparing a course portfolio;

3. Identify all the problems facing the initialisation of a course portfolio and carry out its implementation; and

4. Develop a web-based system to automate a course portfolio and its processes, with the ability for analyzing course portfolio data.

1.5 Research Significance

This research identifies the need of developing and promoting a comprehensive Smart Electronic Portfolio (SEP) web portal of course portfolio in Faculty of Computer Science and Information Technology (FCSIT), University Malaya.

Research significant normally imply to two users type: researchers and practitioners. For researcher, the research provides a good base for further study in the field of course portfolio. The research deeply study the concept, contents and the important role of course portfolio in any education institutes.
On the other hand, the research conducted on the system users identifies the awareness of the current system and the willingness to transform from practicing the conventional method of managing the manual file system to the modern method of managing through a webportal. Moreover, the research is replacing the work intensive, space-hogging file cabinets with a fully automated paperless environment. The users of the system are more productive with regard to the automation of course portfolio processes, and get an immediate response to a document inquiry by:

- Providing a universal access to accurate administrative forms;
- Building a base for the sharing and exchanging of knowledge among course portfolio users;
- Reducing administrative time and costs for handling course portfolios;
- Streamlining the process of storing, accessing, updating and auditing course portfolios; and
- Devoting more time and resources to learning.

### 1.6 Outline of the Thesis

The thesis is comprised of seven chapters; as shown in Figure 1.1. In the First Chapter, introduction, background and research problem are presented. The Second Chapter consists of literature review. In Chapter Three, the methodology used in the study is explained. Meanwhile, Chapter Four, reports the case study and data collection. Chapter Five reports on the data analysis and results of the study. System design and Implementation is presented in Chapter Six. System testing and evaluation is also reported. Finally, Chapter Seven presents the discussion, conclusion and further research to be done on the subject.
Figure 1.1 Thesis Outline
Chapter 2: Literature Review

The previous chapter elucidated the background, definition and research problems involved in this area of study. We shall now examine the second chapter, in an attempt to better understand electronic course portfolios. The main purpose of this chapter is to provide the relevant literature review in this field of study.

2.1 History of Portfolios in Education

The idea of portfolios for education is the brainchild of the progressive education movement reforms begun about a century ago, and is inseparable from the notion of authentic assessment (Lunce, 2004). Research on the use of educational portfolio takes into account a broad spectrum of user objectives and purposes. Pioneering research work suggests three fundamental purposes of portfolio use, more or less the same as with digital portfolios. They include: (a) a showcase of student work (b) a demonstration of learning and (c) a tool for evaluation (assessment) of learning. For instance, Arts students could be asked to collect a portfolio of their best work (showcase). Education majors could be asked to assemble a portfolio that demonstrates their teaching skills (demonstration of learning) (Cambridge, 2001).

Due to the need for accountability (a tool for evaluation), educationalists introduced the term portfolio in the later part of the 1980s, primarily in college writing courses. Barrett (2005) refers to portfolios, rather than showcase portfolios, as products that are
evaluated based on some type of criterion or rubric. She throws light on the rather subtle
difference between portfolio assessment as an effort to address the need for
accountability, and portfolio assessment as a showcase for learning, or to illuminate
capabilities not covered by standardised testing. Barrett goes on to differentiate “portfolios
used for assessment of learning” (i.e., the purpose of the portfolio as prescribed by the
institution) and “portfolios that support learning assessment” (i.e., the purpose of the
portfolio as agreed upon with the learner). Apparently, the portfolio remains a product to
be evaluated, whatever the case might be.

On the other hand, Paulson and Meyers (1991) explored the question of what
makes a portfolio a portfolio. They came to the conclusion that a portfolio is a portfolio
“when it provides a complex and comprehensive view of student performance in context. It
is a portfolio when the student is a participant in, rather than the object of, an
assessment.”

With the ever-advancing frontiers of the context and scope of portfolio assessment,
technology has lived up to the task of making portfolios more compact and accessible,
therefore the conception of digital portfolios.

2.2 Electronic Portfolios

By the mid 1990’s, with the advent of electronic portfolios (E-portfolios), portfolio
use in education was on the rise, most probably due to the ever-expanding use of
technology in education (Mathews 2004). He depicted the birth of E-portfolios as coincident with the invention and expansion of web technology. Institutions in the education business began looking at how to employ technology in enhancing the accessibility and the organisation of print-based portfolios. Early E-portfolio studies outlined a “how to” approach to move print-based portfolios into electronic versions, laying emphasis on definitions, terminologies and classifications (Avraamidou & Zembal-Saul 2006).

In 2002, Batson pointed out an assemblage of three trends that made E-portfolio use so appealing. These three trends include:

1. *Student work is now mostly in electronic form*, or is based on a statutory electronic file, even if it is printed out: papers, reports, proposals, simulations, solutions, experiments, renditions, graphics, or just about any other kind of student work.

2. *The Web is everywhere*: We consider that students nowadays have any time access to the web (this is not an absolute truth). All the material already exists on the internet, leaving students with little to do in digitizing their work.

3. *Databases are available through Web sites*, allowing students to manage large volumes of their work. Web developers are now in the habit of designing “dynamic” database-driven, instead of the conventional HTML link-driven websites.

Lately, a number of definitions pertaining to digital/electronic portfolios, E-portfolios, web portfolios, or webfolios have been propounded. Batson (2002), Barrett
(2005), and Avraamidou (2006) have made varied attempts at the definition of these terms. More recently, digital, electronic, or webfolios have been construed as E-portfolios. (Siemens, 2004) acknowledges that variations may characterise the definitions of digital portfolios, “…but generally include the notion of a digital resource (personal artefacts, instructor comments), demonstrating growth, allowing for flexible expressions (i.e. customised folders and site areas to meet the skill requirements of a particular job), and permitting access to varied interested parties (parents, potential employers, fellow learners and instructors)”.

According to Barrett (2005), E-portfolios are defining a new platform for other already established portfolios across the education field, and can be developed along two lines: using generic tools such as word processors, HTML editors, multimedia authoring tools, PDF (Portable Document Format), and other productivity software tools in common use; and using a customised system approach involving servers, programming and databases.

Barrett (2004) defines E-portfolio as a tool that “…uses electronic technologies as a container, allowing students/teachers to collect and organise artefacts in many media types (audio, video, graphic, text); and uses hypertext links to organise the material, connecting evidence to appropriate outcomes, goals or standards”. Barrett differentiated the traditional portfolio development process from a process enhanced by adding technological landmarks, as presented in Table 2.1.
Traditional Portfolio Process include:   Adding Technology allows enhancement through:

- Collecting
- Selecting
- Reflecting
- Projecting
- Celebrating

- Archiving
- Linking/Thinking
- Storytelling
- Collaborating
- Publishing

| Table 2.1 Barret Comparison of Portfolio Development Process |

In an EDUCAUSE Learning Initiative, Lorenzo and Ittelson (2005) defined an e-portfolio as “…a digitised collection of artefacts, including demonstrations, resources, and accomplishments that represent an individual, group, community, organisation, or institution, that are comprised of text-based, graphic, or multimedia elements archived on a Web site or on other electronic media such as CD-ROM or DVD”. They also made mention of a University of British Columbia definition, from the Office of Learning Technology, which states that an e-portfolio is a “…personalised, Web-based collections of work, responses to work, and reflections that are used to demonstrate key skills and accomplishments for a variety of contexts and time periods.” It is obvious that definitions for a digital portfolio abound, but they all have one thing in common, no matter the source of the definition, or the viewpoint of its proponent: digital portfolios use computer technology, and more recently, as stated by the University of British Columbia, Office of Learning Technology, are Web-based.

2.3 Categories of Electronic Portfolios

Varying views have been given on expressed concerning the different categories of E-portfolios, abounding definitions already in existence not withstanding. Lankes (1998) is one of those to have given a viewpoint, relating that E-portfolios can be categorised based
on how they are used. Lankes classifications include: *Developmental* (keeping track of students' progress in a particular subject), *Proficiency* (used to prove mastery in a particular subject area), *Showcase* (documents students’ best work), *Teachers’ Planning* (used to acquire information about an incoming class of students), *Employment Skills* (used to evaluate a prospective employee’s work readiness skills), and *College Admission* (Lankes 1998)

Cambridge et al (2001) outlined a new and extensive class of E-portfolios, based on initial ownership: student, faculty or institution. Lorenzo and Ittelson (2005) could not agree less, as he listed a similar class of portfolios: student e-portfolios, teaching e-portfolios, and institutional e-portfolios. Looking at a broad spectrum of E-portfolios in the different classes listed thus far, it appears appropriate to further sub-categorize these classes in terms of more details on their content and use. For instance, Hamp-Lyons and Condon (1998) characterized a E-portfolio category as typically containing student work, self reflection, and perhaps faculty feedback. They said student E-portfolios can be employed in varied ways, for varied purposes, including evaluation/grading, showcasing, and student learning (includes developmental and programme/discipline specific).

Cambridge et al (2001) construe faculty E-portfolios as bearing information in such areas as course and syllabus development, assessments, peer reviews and learning activities. They further to list uses of faculty portfolios, namely teaching assessment, course assessment, and personal growth and reflection. On the institutional class of digital
portfolios, Cambridge et al explains that they contain information about a particular programme, accreditation information and student outcomes. They can be put into such uses as programme assessment, course assessment and faculty assessment. However, Cambridge et al (2001) acknowledge the flexibility of these uses, as well as of those in the general categories, allowing E-portfolios to be alternatively classifiable according to other uses.

Besides categories based on contents and uses, Love et al (2004) created five categories based on the level of maturation of E-portfolios. These categories include: Scrapbook, Curriculum Vitae, Curriculum Collaboration, Mentoring Leading to Mastery, and Authentic Evidence as the Authoritative Evidence. These five levels of maturation were designed to help institutions implement E-portfolios in an incremental way. To create their levels of maturation, Love et al (2004) described eight physical and theoretical qualities inherent in portfolio/webfolio processes, and their application. These include:

1. Type of portfolio/webfolio – working or showcase

2. Organisation of the portfolio/webfolio

3. Type of student artefacts in the portfolio/webfolio

4. Presence and capture of feedback, and assessment based on standards

5. Nature of the portfolio/webfolio content – static, dynamic, and/or evolving

6. Heuristic processes involved in developing the portfolio/webfolio
7. Context provided for each item in the portfolio/webfolio

8. Delivery mode for the portfolio/webfolio

Each quality listed brackets both use and content, and has no small commonality with the earlier-mentioned classes of E-portfolios. Whatever the manner or perspective of categorization, three things appear undeniable: E-portfolios have come a long way, and they have come to stay. They are “…heralded as the ‘next big thing’ in some educational technology circles” (Murphy 2003).

2.4 Tools Used for the Construction of Electronic Portfolios

Deserving equal attention in any literature on E-portfolios as their manner of classification is the tools used in constructing them. A lot of writing has been done on the tools different institutions use in this bid, with frequent mention of such software tools as word processors, HyperStudio, Microsoft Office and Adobe PhotoShop, which are usually stored on a CD-ROM (Gibson & Barrett 2003). Another very common on-line tool is HTML, alongside a large assortment of web page templates (Avraamidou & Zembal-Saul 2006).

E-portfolios construction tools have also been widely classified. Gibson and Barrett (2003) propounded two classes of tools, depending on its degree of adaptability. The first type is generic tools, in which users adapt general purpose tools (productivity software,
word processors, HTML editors, multimedia authoring tools, PDF formats) to suit their specific E-portfolio construct. Institutions store these tools on whatever digital storage space that may be available to them (CD-ROM, hard disks, etc.). The second type, a customised system approach, involves servers, programming and databases. Typically employed by educational systems and established companies, the data needed for these tools are hosted on well structured on-line databases with servers for convenient storage and organisation. It has been referred at the beginning of the paragraph that the first type entails the use of multimedia tools and HTML, starting with a “blank slate” and building a unique batch of E-portfolios when marked structural differences from batches constructed by other users using the same tools. The second approach, on the other hand, as customised as it already is, provides a framework that can afford little difference from constructions made by other users. It is less flexible, and demands little knowledge of HTML or web construction. It provides an on line application for the user, and appears more top-down and controlled by the educational programme/institution.

In addition to “home grown” E-portfolios or open-source initiatives, commercial technology tools have been mass-developed in the last few years, affording users flexibility in constructing E-portfolios according the any one of the types, purposes and uses we have seen so far (Gibson & Barrett 2003).

The January 2003 issue of Syllabus (Pielke 2003) listed a product round-up that described five of these commercial E-portfolio products:
1. **iWebfolio**: Created by Nuventives, this product lets instructors and educationalists evaluate student work done and stored across numerous portfolio platforms. A student must explicitly allow access to any material stored with a specific portfolio. To ensure that students do not access their own assignments after a specified submission date, the faculty can request and see that students lock their portfolio. iWebfolios are housed on the Nuventive server.

2. **Folio**: Created by ePortaro, this product is designed as a common channel for students and an institution, where students and instructors (or staff) can place information pertaining to the student in question. As is evident, students can store (a) documents they produced themselves (word processing, spreadsheets, graphics or other electronic documents); (b) and standard forms supplied by the Folio or by the university. The folio is the main repository where all this information is stored. The university can certify as correct, some of the information in the folio, such as the grades of a student. Students are allowed to create different portfolios, using a subset of the data available. Portfolios are usually housed at the institution, although ePortaro does offer hosting services.

3. **E-Portfolio**: Created by Chalk & Wire, this product allows students and faculty not schooled in web design to create showcase portfolios. This software provides groundwork such as INTASC and ATE, on which portfolios can be created. Portfolios can be stored on the institution’s site or on Chalk & Wire’s server.

4. **FolioLive**: Created by publisher McGraw-Hill, this product is mainly concerned with course-level assessment. It provides the options of creating portfolios using in-built, ready-made “frameworks”, or creating one's own custom designs. Instructors are allowed to
comment on the work of any student they choose to. Portfolios are housed on McGraw-Hill’s server.

5. **Web Folio Builder:** Created by TaskStream, this software is designed with the typical needs of teachers in mind. Teachers are provided a functionality by which they can assemble portfolios to serve a cross-board of academic and professional needs. Student teachers can submit work to instructors/guides for assessment and can organise their work in accordance with state and national standards. Portfolios are housed on TaskStream’s servers.

### 2.5 Electronic portfolio in Malaysia

The University Technology Malaysia (UTM) is considered the first university in the country that has developed and deployed an E-portfolio system for its student to record their academic progress and learning reflection. The project was started in 2005 as one of the tools to monitor and assess the acquirement of UTM Graduate Attributes among its students. By introducing E-portfolio, UTM is aiming to:

- To give added values to an effective learning culture.
- To share their work with potential employers.
- To inculcate the culture of writing and documenting information.
- To help students to recognize their own potential and skills in terms of knowledge, technical and generic.
- To help the University and the stakeholders to monitor students development from many aspects.
• To assist the academic progress and career development of the student.
• To be used as an instrument to assess the effectiveness of an academic programmed.
• To be used as a proof on student achievement as prescribed in the statement of programmed learning outcome.

UTM states that implementing of E-portfolio has brought benefits to university in three different pivots:

• **Benefits to the students**

  The development of the E-portfolio has many benefits to the students: it increases their ability to understand what they have learnt; it allows them to understand their learning styles; and it provides opportunities for the students to reanalyzed, plan and take full accountability towards their learning. In addition to that, the students can also use the portfolio as a tool for their career development.

• **Benefits to the University**

  The portfolio has been used by the Faculties as one of the sources to get feedbacks on the effectiveness of the curriculum or the academic programmed offered. The information can also be used to provide help to the students to increase their accountability towards their own learning. Apart from that, this portfolio can also be utilized as a tool to measure the Programme Learning Outcomes for the academic programmeds being offered. The University can also make use of the
results from the feedbacks to improve the quality of teaching and learning in general.

- **Benefits to the stakeholders**

The stakeholders will be able to utilize the E-portfolio for many purposes. For instance, with the student consent, parents, sponsors and potential employers will be able to identify the student learning development in terms of the academic, social, skills and career planning. They will also be able to see a sample of good work done by the students. In terms of auditing and accreditation purposes, the professional body and enforcement agency will also be able to observe the effectiveness of the academic programmes offered by the University through the portfolios.

### 2.6 E-portfolio and E-learning

E-portfolios may often be used on their own, but they can also be one service within a complete E-learning environment (Banks 2004). Grant (2005) states that most E-learning systems can be viewed as E-portfolio related, in that they generate or store information which could be regarded as E-portfolio items. Even the simple course definition may be useful as an E-portfolio item, perhaps to be shown to other people interested in a person's educational experiences. And with an increasing use of E-learning systems to capture, record, or mediate students' work, the range of associated E-portfolio items increases.
2.7 Course Portfolio

2.7.1 Introduction

A course portfolio is created in an attempt to archive one’s teaching practices in a particular course over a period of time. As opposed to a teaching portfolio (which essentially highlights the teacher), or a student portfolio (which stresses the content of the portfolio, mirroring the amount and progress of learning), a course portfolio is about process, about tested and proven methods already used in teaching, learning and development. It is an assemblage of past methods and approaches used in the teaching and learning process, with an eye to the future and the possibility of improvement (Hutchings 1998). As such, each course becomes a sort of “laboratory - not as a truly controlled experiment... but as a setting in which [teachers] start out with goals for student learning.... and collect evidence about effects and impact” (Cerbin, 1994).

Cerbin (1994) stated one logical and straightforward reason for documenting these teaching methods and their outcomes, the so-called “evidence about effects and impact”, which is to salvage what Shulman et al (1996) construed as “pedagogical amnesia”. Shulman was pointing to a common and apparently incurable trend in which teachers, when they teach, make notes of varying degrees of importance, usually concerning the learning needs and difficulties of their students. However, due to varying reasons, among which are time-constraint and loss of vital pieces of information, the intended changes and considerations are seldom made. As course portfolio, as William Cutler (2006) opined, is a strategy to set teachers on the right footing as they purpose to make a record of all necessary assessment and changes of their teaching methods. Proceeding this way adds caution and
accountability to the task of teaching, in which a faculty “thinks more carefully about what its students are learning and how that learning relates to the content and methods of instruction”.

Many are beginning to welcome the use of electronic course portfolios, and acknowledge its adequacy in storing and sharing work. Members of the American Association for Higher Education’s (AAHE) Course Portfolio Working Group have created and shared instances in a variety of disciplines, including Biology, English and Nursing (Hutchings, 1998), which have allowed for a common ground where teachers and colleagues can discuss aspects of pedagogy and other teaching outcomes. In such environments, the realities of teaching are unveiled, and heuristics and experiences are shared, which Parker Palmer (1993) terms as opportunities for “good talk about good teaching.” Finally, they have thrown light on the learning needs of different classes of students, both within and across departments and institutions, which have led to common practices in the teaching profession designed to meet these needs.

### 2.7.2 Course Portfolio Elements

A staunch advocate and pioneer of the development of course portfolios, in the person of William Cerbin (1994), advances four major parts in the development process: a teaching statement, an analysis of student learning, an analysis of student feedback, and a course summary. Other advocates, such as Chein (1998) state that the portfolio has to ‘tell a story of the course’; Hutchings (1998) mentions three components to a course portfolio: documenting course design, enactment, and student learning. Faculties normally choose a
portfolio design that will cater for their discipline, course and mode of reflection. Basically, the major elements of a course portfolio are: (1) teaching philosophy; (2) course design and objectives; (3) documentation/artefacts; and (4) assessment of the course. Hutchings (1998) notes some artefacts used: handouts that relate to key assignments; reports from student group work, examinations or quizzes, readings, and study guides. According to Dubinsky (2003), these elements include:

I. Introductory Information

II. Course Design

   A. Rationale

   B. Reflective Essay on Course Content

   C. Reflective Essay on Instructional Practice

   D. Problem-Based Learning: Context and Application

III. Student Understanding

IV. Reflective Summary of the Course

These elements are aimed at helping teachers select and assemble material and tools good for recording student learning patterns and needs in their different classes. Teachers should therefore use them only as a guide. It is not necessary, though it is possible, to include all of them in a particular course portfolio. For example, a teacher may decide to exclude an essay on instructional practice, and include a daily journal instead, and need might reflect. A new and common trend is occurring, in which teachers including in their
course portfolios, digital photos and video records of some events in the learning classroom, which has apparently has an impact on the teaching/learning environment.

Assembling these materials is just the first of four key steps, which are often outlined as *collect, select, reflect and cone* (*Cambridge et al. 2001*). After gathering these materials, it is important to assort them in some manner and closely examine them. By closely examining what has happened, what is happening and what might happen, teachers make easily and comfortably make all needed changes. Hutchings (1998) observes that “Reflective teaching will allow [teachers] to act in deliberate and intentional ways to devise new ways of teaching... and to interpret new experiences from a fresh perspective.”

All in all, these materials must be constantly reviewed and updated to reflect current research and scholarship standards, if they are to continue addressing the current learning needs of any institution and/or society. They must therefore be open to public scrutiny and criticism, and be so organised with the accommodation of these in view, so as to ease what Barkley calls “the messy complexity” of teaching and learning (*Barkley 2001*).

Table 2.2 summarizes the main components of course portfolio. This table is developed by analyzing the work done by the earlier researchers.
<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching statement</td>
<td>General objectives of the course</td>
<td>(Cerbin 1994), (Dubinsky 2003)</td>
</tr>
<tr>
<td>Course Design</td>
<td>• Syllabus&lt;br&gt;• Schedule/Calendar&lt;br&gt;• Course description&lt;br&gt;• Goals&lt;br&gt;• Objectives&lt;br&gt;• Course topics or concepts&lt;br&gt;• Learning outcomes</td>
<td>(FAST &amp; ARMSTRONG 2003), (Dubinsky 2003)</td>
</tr>
<tr>
<td>Student learning</td>
<td>• Assignments&lt;br&gt;• Readings&lt;br&gt;• Exercises&lt;br&gt;• Overhead copies&lt;br&gt;• Lecture notes&lt;br&gt;• Quizzes/Tests&lt;br&gt;• In-class/out-of-class activities&lt;br&gt;• Labs/Demonstrations&lt;br&gt;• Study Questions/Guides&lt;br&gt;• Research/Inquiry questions&lt;br&gt;• Hard copies of individual and group list discussions</td>
<td>(Hutchings 1998), (Dubinsky 2003)</td>
</tr>
<tr>
<td>Course analysis</td>
<td>• Learning outcomes&lt;br&gt;• Student papers&lt;br&gt;• Quizzes&lt;br&gt;• Tests&lt;br&gt;• Oral reports/presentations/demonstrations&lt;br&gt;• Lab reports&lt;br&gt;• Conferences&lt;br&gt;• Surveys&lt;br&gt;• Evaluation rubrics&lt;br&gt;• Grades</td>
<td>(FAST &amp; ARMSTRONG 2003), (Cerbin 1994)</td>
</tr>
</tbody>
</table>
2.7.3 Benefits of Electronic Course Portfolios

In encapsulating potential benefits that Electronic course portfolios (hereafter we will use E-portfolio) may hold for both students, faculty and administrators, Batson (2002) points out that most students seemed especially interested in how E-portfolios can be used in the building of resumes, both before and after graduation. He also mentions that students might want to keep track of the progress of their college career with regard to requirements (depending on the type of digital/electronic portfolios), or review their work and instructor comments. Common to both students and faculties is the use of E-portfolios to build resumes, but the latter also use them to enhance teaching excellence and as a blueprint for addressing letters of recommendation. Fundamentally, digital course portfolios benefit faculties in “providing a tool to better manage, review, reflect, and comment on student work”.

Batson (2002) also states that administrators can see the potential value of E-portfolios for:

1. Establishing a method of tracking student work over time, in a single course, with students and faculty reflections.

2. Collecting the work of many students in a particular course into a single container, to assess the progress of all students learning set learning goals.

3. Assessing a multitude of courses in one particular major in a common fashion, in thus ultimately assessing an entire programme of study.
Regarding accreditation, administrators can discover how to:

1. Modify courses according to new teaching methods, and inclining syllabi and curricula towards these goals.
2. Ensure the continuity of student work in courses that span more than one semester.
3. Have a well informed, dynamic and constantly updated view of student progress in a programme, which is very helpful in formative assessment (Batson, 2002).

Siemens (2004) also summarises three benefits of E-portfolios from the perspective of the main participants in the process: learners, instructors and institutions. Beginning with learners, below is Siemens' list of some important benefits of E-portfolios:

1. Personal knowledge management;
2. History of development and growth;
3. Planning/goal setting tool;
4. Assist learners in making connections between learning experiences;
5. Provide the meta-cognitive elements needed to assist learners in planning future learning needs based on previous successes and failures; and
6. Person control of learning history.

For faculty, Siemens (2004) lists the following benefits:

1. A means to share content with other faculties;
2. A move to more authentic assessment (as opposed to testing);
3. Preparing learners for life-long learning; and

4. Creating an assessment-trail that is centralised and under the learner’s control.

According to Siemens (2004), institutions, if they use E-portfolios, can enjoy benefits such as:

1. Adding value to the learning experience by allowing learning personal control over the learning process; and

2. Establishing and playing a fundamental and permanent learning role in the lives of learners. i.e., education is not viewed as a 2 to 4 year relationship, but a life-long relationship.

These, and a host of other benefits of using E-portfolios not mentioned, have the far-reaching goal of focusing on, and addressing the learning needs of students along the lines of development, goal setting, reflection and life-long learning, and not just meaninglessly determining knowledge. Institutions and faculties are equipped with the tools to perceive and handle student learning in a manner that permits development, is dynamic and constantly updated.
2.7.4 Current Course Portfolio Systems

2.7.4.1 WEAS

WEAS is a Web-based Educational Assessment System, developed at the Armstrong Atlantic State University. The WEAS applies Bloom’s taxonomy theory to an evaluation of student learning outcomes and teacher instructional practices with immediate feedback.

The WEAS basically a client/server architecture design. It has a two-module framework: the central server, acting as a depot to store data and the system services provider; and the client devices, such as laptop or desktop computers, Pocket PCs and cell phones. The WEAS contains three functional components, mainly:

a- The Administrator Subsystem, which includes six modules - Login, Student, Instructor, Test, System and Export modules. A system administrator must log in through the Administrator Login Module, and is allowed to manage (e.g. add, remove and update) instructor and student accounts in the Instructor and Student modules respectively.

b- The Instructor Subsystem consists of six modules - Login, Help, Portfolio, Query, Test Creation and Report modules.

c- The Student Subsystem is comprised of nine modules - Login, Help, Portfolio, Query, Test Selection, Self-Assessment, Test Taking, Grading and Report modules.
The WEAS runs on Windows Server 2003 operating system. This server hosts functionalities such as web service and database service. Web server is built with Microsoft Internet Information Service (IIS) and Active Server Page.NET (ASP.NET) (He & Brandt 2007).

### 2.7.4.2 COMPASS

COMPASS is a Computer Science Programme Assessment project, developed at the University of West Georgia. It is a web-based system to document course activities and enable better course evaluation. COMPASS uses open-source software tools (MOODLE) to support the development and analysis of course portfolios.

The distribution of MOODLE, the Modular Object-Oriented Dynamic Learning Environment, an open-source course management system, is regulated and licensed by GNU (General Public License). It's supported by any platform compliant with the PHP scripting language, including UNIX, Linux, Windows and Mac OS X. It is easy to install and administer. All MOODLE data is stored in a single relational database and functions fluently with open-source database management systems like MySQL.

With MOODLE, teachers and instructors can plan course work weekly or topically on their own websites, choose one of a variety of document formats provided in which to post lecture notes, post assignments and notifications and create collections of questions accessible to students. Students and instructors/teachers can interact in a number of ways:
taking/giving objective-format quizzes with automatic grading, providing feedback on assignments, conducting surveys, and running synchronous chats and asynchronous threaded discussions. Students can upload/download assignments, view grades and provide feedback, take part in team activities and make a record of all such activities (Abunawass 2004).

2.7.4.3 Comparative analysis (WEAS vs. COMPASS)

In one hand, both WEAS and COMPASS aim to manage the contents of course portfolio. Their main users are administrator staff, lecturers and students. Both system provide the user with variety of functions that match the user needs.

On the other hand, COPASS is built using an open source module; so COPASS functions can easily be configured regarding to user requirements and specifications rather than WEAS, that come with fixed functions.

2.8 Summary

The review of literature involves various fields such as history of portfolios in education, categories of E-portfolios and tools used for the construction of E-portfolios. The definition of course portfolio and its benefits have been discussed. In addition to that, the main components and elements of course portfolio have been identified. Also, some current portfolio system have been displayed.
In this chapter, the methods for data collection are presented. Throughout the chapter, different perspectives on research methods are explained, along with justifications of the specific methods used in the study.

3.1 Research Purpose

According to Yin (2003) and Zikmund (2000), research can be used for three purposes - exploratory, descriptive and explanatory.

*Exploratory studies* are a valuable means of finding out what is happening, to seek new insights, to ask questions and to assess a phenomenon in a new light (Saunders, Lewis & Thornhill 2007). Robson (2002) explained that an exploratory study is a particularly useful approach if one wishes to clarify the understanding of a problem. The advantage of exploratory research is that it has great flexibility and is adaptable to change. The flexibility inherent in exploratory research does not mean the absence of direction.

*Descriptive research* is described within problem areas, where there already exist plenty of literature works and the aim is to study events that have occurred or are happening in the present time. The aim of descriptive research is to describe the characteristics of a population or phenomenon. It seeks to determine the answers to who, what, when, where and how questions (Zikmund 2000). According to Robson (2002),
the objective of descriptive research is to portray an accurate profile of persons, events or situations. Usually it is taken as an extension of or a forerunner to a piece of exploratory research. Zikmund (2000) noted that accuracy is of immense importance in descriptive research. Though admitted errors cannot be eliminated completely, a good research strives for descriptive precision. It is usually taken based on some previous knowledge and understanding of the nature of the research problem.

Explanatory research is aimed at establishing causal relationship variables. The emphasis here is on studying a situation or a problem in order to explain the relationships between variables (Saunders et al, 2000). Usually, exploratory and/or descriptive research precedes this kind of research, and according to Zikmund (2000), the researcher must be knowledgeable about the research subject.

The research purpose of this study has been assessed as both exploratory and descriptive. The study focuses on explorative research because of the limited knowledge about the research area, and since the research aims to gain a deeper understanding within this field. The research is also descriptive in nature, as the attempt is made to describe the data collected.

3.2 Research Approach

Zikmund (2000) explains that the two methodological research approaches propose two different ways of collecting information. The qualitative approach means
collecting qualitative data, which is often referred to as “soft” data, and containing information about actions or functions. Qualitative data is often presented as words and observations. Furthermore, Yin (1994) states that qualitative methods are often related to case studies, where the aim is to receive thorough information, and thereby obtain a deep understanding of the research problem. Gummesson (2002) mentions qualitative research as being appropriate for research in management and business administration.

In contrast, the **quantitative research** approach involves collecting quantitative data, which implies “hard” data. Quantitative data will often determine the quantity or extent of some phenomena, and is mostly presented as numbers and figures.

A qualitative approach is the most appropriate method to use in this study as the purpose of the study is to gain a better understanding of the adoption implementation of Electronic Course Portfolio in educational institutions, and the answers could not be quantified or measured in numbers or figures.

### 3.3 Research Strategy

With the research approach being qualitative in nature, the focus now turns to the research strategies to collect the data. According to Yin (2003), there are five primary research strategies in the field of social sciences: experiments, surveys, archival analysis, histories and case studies. Each strategy has its own advantages and disadvantages, depending on three conditions:
• The type of research questions posed;
• The extent of control an investigator has over actual behavioural events; and
• The degree of focus on contemporary, as opposed to historical, events.

According to Yin (2003), these three conditions are all related to the five research strategies, as shown in Table 3.1

**Table 3.1 Research Condition and Research Strategies**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Form of Research Questions</th>
<th>Requires Control over Behavioral Events</th>
<th>Focuses on Contemporary Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>How, why</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Survey</td>
<td>Who, what, where, how many, how much</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Archival Analysis</td>
<td>-</td>
<td>No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>History</td>
<td>How, why</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Case Study</td>
<td>How, why</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Since this study focused on contemporary events and did not require control over behavioral events, history or experiment strategies were not relevant and appropriate. The research questions for this study both started with “How” and “Why”, which implied that experiment, history or case study strategies were recommended.
Consequently, case study was found to be the most appropriate research strategy, where all the three conditions were fulfilled, and hence was used in this study. When the research only focuses on a few objects from several different aspects, and when the researchers ask “How” and “Why” questions, the case study strategy is used. Case studies are also often used when the researchers have little control, and the focus lies on a contemporary phenomenon within real-life context (Yin 2003).

### 3.3.1 Case Study

Case study is a technique which intensively investigates one or a few situations similar to the researcher’s problem. The advantage of carrying out a case study is that an entire organisation or entity can be investigated in depth. This enables the researcher to study, for instance, the sequence of events, or the connections between functions and individuals. However, the results obtained from a case study should be seen as tentative and not conclusive as most situations can be typical in some sense and so it is dangerous to make generalisations based on the results.

According to Yin (2003), there are two types of case studies that a researcher can consider: single and multiple. A single case study is when one entity is investigated, while a multiple case study is when two or more entities are compared and examined. A multiple case study should serve as multiple studies, where the results are predicted before the investigation is carried out. It therefore allows for comparison between different cases and the opportunity to discover similarities and differences.
Having considered the points above, a single case study is used as the research strategy for this study. The case study has helped to gain a better understanding of the research area. The Faculty of Computer Science and Information Technology, University Malaya (FCSIT hereafter) is considered the case study of this research. The FCSIT case study is explained in more details in Chapter 4.

3.4 Data Collection

The data collected can be classified as primary versus secondary data. Primary data is gathered and assembled specifically for the research project at hand (Zikmund, 2000). Secondary data has already been collected for purposes other than the problem at hand.

According to Yin (2003), there are six sources of evidence that can be made the focus of data collection for case studies: documentation, archival records, interviews, direct observations, participant-observation, and physical artefacts. Each of these sources of evidence is explained in Table 3.2
### Table 3.2 Data Collection Source Evidence

<table>
<thead>
<tr>
<th>Source of Evidence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentation</td>
<td>The different types of documents include statistics, registrations, official publications, letters, diaries, newspaper, journals, branch literature and brochures. Documents are mostly used for collecting secondary data.</td>
</tr>
<tr>
<td>Archival Records</td>
<td>These can be, for example, service records, organisational records, maps and charts, survey data, and personal records. Archival records are often used in computerised form, also for collecting secondary data.</td>
</tr>
<tr>
<td>Interviews</td>
<td>The interviews mostly take the form of an open-ended nature, in which an investigator can ask key respondents for the facts of a matter, as well as for the respondents’ opinions about events. The interview can also take the form of a focused interview, in which a respondent is interviewed for a short period of time, an hour for example. Moreover, the interview can entail more structured questions, along the lines of a formal survey.</td>
</tr>
<tr>
<td>Direct Observation</td>
<td>This can involve observations of meetings, sidewalk activities, factory work, classrooms, and the like. Observational evidence is often useful in providing additional information about the topic being studied. To increase the reliability of observational evidence, a common procedure is to have more than a single observer making an observation, whether of the formal or the casual variety.</td>
</tr>
<tr>
<td>Participant-Observation</td>
<td>Participant-observation is a special mode of observation in which the investigator is not merely a passive observer. Instead, the investigator may take a variety of roles within a case study situation and may actually participate in the events being studied.</td>
</tr>
<tr>
<td>Physical Artifacts</td>
<td>A final source of evidence is a physical or cultural artifact - a technological device, a tool or instrument, a work of art, or some other physical evidence. Such artifacts may be collected or observed as part of a field visit and have been used extensively in anthropological research.</td>
</tr>
</tbody>
</table>

This research has employed three approaches of collecting data:

#### 3.4.1 Observation

An observation can give useful insight into problems, work conditions, bottlenecks and methods work (Avison & Fitzgerald 2006).
Observation is the first method used to gather information regarding the development of a web-based Smart E-Portfolio System. Observation helps to identify the potential users of the system. For the purpose of this research, the dean office in FCSIT was visited to observe the current system used and to know how the administrator staff handle the course portfolio. Also, an observation has been done on my supervisor during one semester; to observe how the course portfolio is been collected and prepared.

3.4.2 Documentation

The second method used to collect data for this research is document analysis. Documentation included collecting information such as FCSIT minutes of meeting, circulars and internal documents gain more knowledge in the research area. This type of data is described as primary data because it has not been published for public.

During the observation process, the documents that related to course portfolio have been collected and filed. The collected documents will validate the findings from the literature review. These documents are displayed and discussed in chapter 4.

3.4.3 Interviews

The third method used to collect the data for this research is through interviews. This method is chosen as it presented a significant source of information for a case study.
(Yin, 2003). The type of data used in this method is called primary data as it is collected for a specific purpose by the researcher. There are three different types of interviews, mainly open-ended, focused and structured.

An open-ended interview is used when the respondent is allowed to answer the questions in his/her own words. A focused interview is bound to a certain degree as despite following a set of questions, it is performed in an informal, conversational manner. The third type, which is a structured interview, is based on a survey, in which the researcher without any flexibility predetermines the questions (Yin, 2003).

An interview can be conducted over the telephone or in person. The most qualitative interview is done on a one-to-one or face-to-face basis. Some of the great advantages of interviewing someone in person are that it can include questions that are more complex, and that it can be conducted over a longer period of time.

In this research, a one-to-one question and answers sessions were held. The interviews were recorded and reviewed later while incorporating researchers’ additional remarks. A total of two interviews were held with a number of FCSIT staff which include my supervisor and the head of administrator staff who is responsible of the faculty course portfolio. The selection of participants was based in their role and influence in the lifecycle of course portfolio. Interviews with these practitioners were used to get the initial functional requirements of the application.
The data gathered was then used to identify the data entities and hence the design of the application. The questions and the result of interview were display in Chapter 5.

3.5 Summary

This chapter has discussed the research methodology, research techniques, and research tools which are used in this dissertation. Research methodology produces the main guidelines for developing SEP. The research techniques are used to collect and capture requirements from end users who were interviewed and observed during work time. In Chapter 4 and Chapter 5, the output of the data collection process have been displayed and discussed.
Chapter 4: Case Study

In this chapter, the case study on which the research is based is presented. The chapter start with the description of the University of Malaya’s Quality Management and Enhancement Centre (QMEC), followed by the Faculty of Computer Science and Information Technology, its course portfolio and lastly, its major stakeholders.

4.1 The University of Malaya

The University of Malaya (UM) is the first and oldest public university in Malaysia. Traditionally, this university provides education, research works and services to the entire society. UM has its roots in Singapore, with the establishment of King Edward VII College of Medicine in 1905, followed by the Raffles College in 1929 to meet the needs for medical and tertiary education. On October 8, 1949, the University of Malaya was formed with the amalgamation of both colleges. The unification paved the way for the university to emerge as a higher learning institution, which would cater for the tertiary education needs of Federated Malaya and Singapore (University of Malaya Student Handbook, 2007).

The growth of the university was very rapid during the first decade of its establishment, and this resulted in the setting up of two autonomous divisions in 1959, one located in Singapore and the other in Kuala Lumpur. In 1960, the government of the two territories indicated their desire to change the status of the divisions into that of a national
university. Legislation was passed in 1961 and the University of Malaya was established on January 1, 1962.

To date, the University of Malaya has an estimated population of about 25,000 registered students pursuing various levels of courses. The university has 12 faculties, 2 academies, 3 centers and 2 institutes.

4.2 Quality Management and Enhancement Centre (QMEC)

June 2002 was a turning point in UM’s history, with the formalisation of the university’s Quality Management System (QMS). Based on the framework and requirements of MS ISO 9001:2000, the UM QMS encompassed all core processes, which included teaching and learning, research and consultation, and supporting services. On December 24, 2002, as listed in the Malaysia Book of Records, UM became the first Public Higher Education Institution (PHEI) to be certified with the MS ISO 9001:2000 on a comprehensive basis.

The QMEC was formed on July 27, 2002, with the aim of managing and coordinating activities associated with the UM QMS. QMEC has been actively engaged in coordinating, strengthening and continually improving the UM QMS. These activities include conducting training sessions, courses and workshops in an effort to instil awareness amongst the staff of UM, as well as stress the importance of ensuring quality in all aspects of the organisation. QMEC’s scope has since expanded to include other quality
assurance framework, namely the criteria for the Ministry of Higher Education Quality Management, Research University, University Ranking, and ASEAN University Network Quality Assurance. QMEC has five main sections, which include:

4.2.1 Documentation Section

The Documentation Section consists of a Document Manager, an e-Document Manager and other members, who are responsible for the management of controlled quality documents, which are currently available online through the QMEC website.

4.2.2 Internal Quality Audit Section

The Internal Quality Audit Section is headed by a Chief Auditor, who is assisted by a Deputy Chief Auditor and Assistant Auditors. This section coordinates the University’s internal quality audit exercises, which aim to check on the University’s compliance with the UM QMS.

4.2.3 Training and Awareness Section

The Training & Awareness Section comprises a Manager and other QMEC members. The section’s main function is to coordinate training in all aspects pertaining to quality in UM. Activities on awareness and appreciation of the UM QMS are regularly and continually conducted for all levels of UM staff.

4.2.4 Quality Assurance Section

The Quality Assurance Section members include a Manager as the section’s head. Its main responsibility is to coordinate activities with regard to the Quality Assurance of PHEI in UM. It is responsible for monitoring internal quality assurance activities,
disseminating good practices, and conducting awareness and training programmes in quality assurance.

4.2.5 Customers Feedback and Continuous Improvement Section

This section, consisting of a manager and other members, manages matters pertaining to feedback/complaints from customers. The Customer’s Satisfaction Survey, as well as the Continual Improvement Projects are also carried out and assessed by this section.

4.3 Faculty of Computer Science and Information Technology

Historically, the computer facilities and services at the University of Malaya were provided in mid 1967 by the Computer Centre, which was formed in 1965. In December 1969, the centre also took an additional role of teaching and research in the field of Computer Science and Information Technology (FCSIT, Annual Report, 2002).

A post-graduate Diploma in Computer Science was then introduced in 1974. During the 1990/91 academic session, the centre began offering the Bachelor of Computer Science (CS) programme, with a maiden intake of 50 students. After various proposals, the University’s Council, in September 1994, agreed to the formation of the Faculty of Computer Science and Information Technology (FCSIT), and a separate Computer Services Division. The Bachelor of Information Technology (IT) commenced during the 1996/97 academic session. At present, the faculty has four departments: Artificial Intelligence, Software Engineering, Information Science, and Computer Systems and
Technology. Apart from the two Bachelor programmes, its graduate studies also currently offer Masters and Doctor of Philosophy programmes in Computer Science, Information Technology, Software Engineering and Library and Information Science.

4.4 FCSIT Course Portfolio

The University of Malaya course portfolio contents are designed by QMEC and are used by every faculty in the university. The contents of the course portfolio are tabulated into a form referred by FCSIT as (Senarai dan susunan kandungan FAIL KURSUS) in Table 5.1 in Chapter 5.

In the beginning of each semester, any lecturer who is assigned a subject to teach during the semester must create a file that contains all the elements of the course portfolio as stated in the table above. By the end of the semester, the Quality Committee of the faculty will audit the course portfolio created by the lecturer to make sure that the lecturer has completed the contents of the course portfolio, and to evaluate the level of course performance. For the auditing process, the Quality Committee of the faculty would use a form named (BUTIRAN FAIL KURSUS) shown in Figure 5.1 in Chapter 5.

To make sure that the Faculty of Computer Science and Information Technology follows and meets the quality standard, and implements the Quality Management System (QMS) of the university, another auditing is done by the Internal
Quality Audit Section, QMEC. Figure 4.1 below summarises the lifecycle of a course portfolio in FCSIT:

![Course Portfolio Lifecycle Diagram](image)

**Figure 4.1 FCSIT Course Portfolio Lifecycle**

### 4.5 Tools Used to Create the Course Portfolio

In FCSIT, there is no special system to create the portfolio. However, the Microsoft Office software package (Word, Excel, PowerPoint) is used to create the contents of the portfolio. The contents of portfolio are printed and save in a folder file. The folder file then is stored in folder rack located in the dean’s office.

### 4.6 Course Portfolio Stakeholders

The definition of a stakeholder has been proposed by Freeman (1983) as follows:
“A stakeholder in an organisation is (by definition) any group or individual who can affect or is affected by the achievement of the Organisation’s objectives.”

Based on the definition above, there are four stakeholders in Table 4.3, who affect the completion of the course portfolio. Based on the study conducted and review of the course portfolio contents and course portfolio lifecycle, the stakeholders include:

Table 4.1 FCSIT Course Portfolio Stakeholders

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer</td>
<td>Creates and completes the course portfolio contents</td>
</tr>
<tr>
<td>Student</td>
<td>Feeds the course portfolio with his/her assignments, tests, quizzes and final exams</td>
</tr>
<tr>
<td>Faculty Quality Committee</td>
<td>-Assigns the course portfolio to the lecturer</td>
</tr>
<tr>
<td></td>
<td>-Audits and reviews the complete course portfolio for quality purpose</td>
</tr>
<tr>
<td>Quality Management and Enhancement Centre (QMEC)</td>
<td>Audits the faculty course portfolios to make sure that the faculty follows and implements the quality standard</td>
</tr>
</tbody>
</table>

4.7 Summary

This chapter has discussed FCSIT which is the research case study. The FCSIT course portfolio contents, lifecycle and stakeholder were identified. The finding of this chapter will clarify the proposed system and user requirements. The next chapter presents and analyzes the data that has been collected.
Chapter 5: Data Analysis and Findings

This chapter analysed the data that has been collected through interviews and observations. The data collection is done to facilitate the process of gathering information about the current system of managing the course portfolio in the faculty. The findings of the analysis done provides guide to determine the requirements of the proposed web based system.

5.1 Observation

An observation can give useful insight into problems, work conditions, bottlenecks and methods work (Avison & Fitzgerald 2006). Observation is the first method used to gather information regarding the development of electronic course portfolio system web portal. A visit has been made with my supervisor to the FCSIT Dean’s office to make personal observation on the existing system use to manage the faculty course portfolio. The observation also intends to look and understand the flow of work process of administering and managing the faculty’s course portfolio. From the observation, it has been found that:

- The current system used is still manual based.
- The files take a large space of the office.
- The contents of some files are arranged in a wrong order or not available.
- The main stakeholders who have direct work with the course portfolio are the administrative staffs and lecturers.
From the above findings, both the administrative staff and lecturers have been identified as the source for data collection and interview.

5.2 Document Reviews Method

Document analysis is done by reviewing either electronic documents or printed documents, such as reports from the web and/or other pieces of written information for content and themes. The reviewing process is where and when the sticky notes are placed, written on, or even attached to other reading materials that are read to make the document reviews more comprehensive and easier for reference. All these are useful sources for the contents of this dissertation.

During the visit to the FCSIT Dean’s office for observation purpose, the documents related to the course portfolio had been collected. The two documents found are described below:

5.2.1 FCSIT Course Portfolio Contents

Table 5.1 describes the contents of the course portfolio that need to be completed and stored in the manual folder file created by every lecturer.
<table>
<thead>
<tr>
<th>Index</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Proforma</td>
</tr>
<tr>
<td>1b</td>
<td>Teaching Schedule</td>
</tr>
<tr>
<td>2</td>
<td>Specific Teaching Schedule (Sharing course lecturers)</td>
</tr>
<tr>
<td>3</td>
<td>Tutorial Framework/Practical (if relevant)</td>
</tr>
<tr>
<td>4</td>
<td>Copy of tutorial/assignment/project/test questions (continuous assessment). Whatever training that has been given to students together with the answer schema should be clearly labelled as Tutorial1, Tutorial2, etc. a) assignment i) number of assignments ii) number of schema b) test i) number of tests ii) number of schema</td>
</tr>
<tr>
<td>5a</td>
<td>Copy of exam questions after it has taken place</td>
</tr>
<tr>
<td>5b</td>
<td>Answer schema</td>
</tr>
<tr>
<td>6</td>
<td>List of students printed from ISIS</td>
</tr>
<tr>
<td>7</td>
<td>Students’ attendance record (should highlight any class that has been adjusted, arranged chronically (state the incomplete dates, ensure that there are at least 14 or 12 number of dates for tutorial/lectures)</td>
</tr>
<tr>
<td>8</td>
<td>The record of class adjustment application (if available)</td>
</tr>
<tr>
<td>9</td>
<td>Letter of proof for student’s absence (such as Medical Certificate, etc.)</td>
</tr>
<tr>
<td>10</td>
<td>Action that has been taken on students who are absent from class three times or the percentage of absence is &gt; 20%</td>
</tr>
<tr>
<td>11</td>
<td>Form signed by students as proof of submission of their assignments</td>
</tr>
<tr>
<td>12</td>
<td>Record of assessment marks of continuous students’ achievements (every row should be labelled clearly)</td>
</tr>
<tr>
<td>13</td>
<td>Record/report of course evaluation by students (after being accepted from Quality Assurance Unit/ Dean’s office)</td>
</tr>
<tr>
<td>14</td>
<td>Grades (not marks) obtained by every student in that course (after the Examiners Board Meeting)</td>
</tr>
<tr>
<td>15</td>
<td>Histogram of students’ grades (after the Examiners Board Meeting)</td>
</tr>
</tbody>
</table>
The form below (Figure 5.1) is used by the faculty audit committee to make sure that the course portfolio for courses taught is complete and follows the contents as described in Table 5.1.

**Details of course portfolio**

<table>
<thead>
<tr>
<th>Course code:</th>
<th>Semester:</th>
<th>Session:</th>
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<tbody>
<tr>
<td>Course name:</td>
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<td></td>
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<tr>
<td>Lecturer’s name:</td>
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<td></td>
</tr>
</tbody>
</table>

Name & signature of examiner: Date of file check/correction made: Informed date to the lecturer:

Tick ✓ or X or * in the following table:

| ✓ complete | ✓ available but incomplete |
| X no |

<table>
<thead>
<tr>
<th>1a</th>
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<th>2</th>
<th>3</th>
<th>4a</th>
<th>4a</th>
<th>4b</th>
<th>4b</th>
<th>5a</th>
<th>5b</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
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<td></td>
<td>✓</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The lecturer of the course is asked to ✓ in the provided space below:
Correction (if necessary) has been done. (✓)

Lecturer signature:
Date of correction update:
5.2.3 Finding from Document Reviews

From the documents that have been collected and reviewed, it is found that the FCSIT course portfolio elements match the course portfolio elements that have been found and discussed in chapter 2. The components of course portfolio mentioned in Table 5.1 will be considered in designing and implementing the proposed system.

5.3 Interviews

Interview provides the opportunity for face-to-face contact and deep exploration of any key section of the data provided by the interviewee. Its objective is to gather information about the user’s expectations, needs, thoughts, past experiences and other related information in a semiformal format.

In constructing the prototype for SEP web-based system, interview is conducted to capture any missed out information directly from users or persons related to the developed system. The criteria for interviewee selection are based on the knowledge background of FCSIT course portfolio and direct impact in course portfolio. Based on these criteria and from the finding of observation, interviews were conducted with the head of administrator staff that is responsible of FCSIT course portfolio (hereafter first participant) and my supervisor as senior lecturers in FCSIT (hereafter second participant)
5.3.1 Interview questions

The objectives of interview questions are to obtain the necessary information for the system requirements. More over, the knowledge based on the respondents’ responses will support us to get insight on developing the prototype system by knowing the difficulties that facing the current system and try to avoid it. For these objectives, the below three questions were asked to interviewees:

Q1: What are the difficulties that you have faced when dealing with the course portfolio?

Q2: How does the faculty utilise and benefit from the data of the course portfolio?

Q3: What are the features that you would look for if the course portfolio is automated?

5.3.1.1 First Participant Interview

Q1: What are the difficulties that you have faced when dealing with the course portfolio?

”The current system is a manual system, which leads to a number of problems. As the faculty has a huge number of course portfolio files stored, some of them may be wrongly placed in the stack. Thus, locating a specific file may at times be very taxing and time consuming. The contents may also be missing or sometimes misplaced. Some of the lecturers prefer to take the files to their office or back home, and may forget to return them back. These are some of the unnecessary setbacks we face at the end of each semester,
when all the files have to be reviewed to make sure that they are complete and have followed the required standard.”

Q2: How does the faculty utilise and benefit from the data of the course portfolio?

“Unfortunately, there are no systems that can benefit from analysing the data.”

Q3: What are the features that you would look for if the course portfolio is automated?

“The system should be able to store the contents of each course portfolio file electronically. No paper work would be necessary, and this will save us the physical space taken up by the manual system. The electronic alternative should also provide a strong tool for searching and auditing each course portfolio.”

5.3.1.2 Second Participant Interview

Q1: What are the difficulties that you have faced when dealing with the course portfolio?

“In the beginning of the semester, I normally go to the faculty office to collect my course portfolio files. Sometimes the staff in charge is busy or not unavailable, and so I would have to wait for a long time or come again later to collect my files, which I consider a waste of time. When the faculty assigns a subject to teach, and this subject is new to me, I have to refer to the previous course portfolio to familiarise myself with the subject. In
some cases, the files would have been taken by other lecturers, or sometimes the files were incomplete or have some contents missing, which makes my job all the harder. During the semester, I start to fill up the course portfolio with its contents. The main issue is collecting and marking the students’ assignments. The collection of assignments is done either in class or in my office, so if I was on leave or not available in the faculty, I would have to come back on weekends or any other day to collect the student’ assignments.”

Q2: How does the faculty utilise and benefit from the data of the course portfolio?

“To me, it doesn’t seem as though the faculty benefits from these data. For example, the course portfolio data can help the faculty to forecast what courses should be taught in the next semester, and the maximum number of students who can take the course.”

Q3: What are the features that you would look for if the course portfolio is automated?

“The system should allow me to fill in the contents of the course file electronically, no need to deal with files or folders physically. The system should also be able to show me when something is missing from the file. The opportunity to search previous course portfolio files should also be available. In addition to this, if the system can allow the students to submit their assignments online, that will be really great.”
5.3.2 Analysis of Data from the Interviews

In responding to question one, both participant one and participant two faced difficulties with current system. Theses difficulties are:

- Storage Problem: dozens of file cabinets are required to keep these course portfolios response (response by first participant).
- Information Retrieval Problem: time required to locate the documents and often the document cannot be found at all or its not complete (response by both participants).
- The disorganisation of course files contents (response by both participants).
- Time spent preparing and processing paperwork such as collecting assignment samples (response by second participant).
- Physical interact with current system

In responding to question two, both participants agree that the FCSIT does not benefit from course portfolio data. There is no system implemented for analysing the contents of course portfolio in order to measure the current performance of the course or forecasting purpose.

In responding to question three, automating the processes of storing, accessing and searching are the most important features that both participants looking for to be in proposed system.
5.4 Summary

This chapter focused on analysing the findings from the data collected from observation, documents review and interviewing. It’s found that the current system used for course portfolio is manual and its users faced problems in using the system. Also, the contents of FCSIT course portfolio had been identified. The findings of this chapter is strongly support the phase of designing and implementing the proposed system in chapter six.
Chapter 6: System Design and Implementation

This chapter details out the design and implementation of the application system. It discusses the application design, the derived application requirements, as well as the development methodology used.

6.1 System Requirements

The requirements for the system are based on the findings from literature reviews, as well as from the findings of data analysis in chapter five. After careful analysis of the findings, the following application requirements were derived:

6.1.1 General Requirements

The general requirements refer to the generic features of the application. These features shall span across the application regardless of functionality and modularity. The derived general requirements were as follows:

- The application should allow the lecturer to upload the contents of course portfolio electronically.
- In order to support the lecturer with ability to manage the student assignments, the application will allow the student to upload their assignments electronically.
- The application must allow the administrator staff to manage and audit the course portfolio uploaded by the different lecturers.
• The application should have the features of analysing the contents of course portfolio.

• From the above mentioned points, the application must be a web-based thin client system. This is to allow users to have greater access to the application.

• The application must operate on an open source platform to allow easier future upgrades and enhancements.

• Application navigation should be easy to use and self explanatory.

6.1.2 User Management Requirements

There should be three main groups of users; administrative staff, lecturers and students. Each user shall have different access level or privilege to the application. The following describes each user’s role:

• The administrative staff has access to manage FCSIT course portfolios.

• The lecturer has access to the system to fill the contents of the course portfolios.

• The student has access to the system to submit the assignments.

6.1.3 Functional Requirements

Functional requirements are important as they are used to determine what the system should be able to do, and the functions it should perform to produce a particular output or outputs that are desired by the system users. The system has three main components as explained in detail below:
1. The Administrative Staff Subsystem includes five modules to:
   a. login to the system using user name and password
   b. view the faculty’s current session and semester portfolios
   c. search the faculty’s previous course portfolios
   d. assign specific portfolios to a lecturer
   e. analyse a specific course portfolio
   f. logout of the system

2. The Lecturer Subsystem includes six modules to:
   a. login to the system using user name and password
   b. view current session and semester portfolios
   c. update certain portfolio contents
   d. collect students’ assignments and tutorial
   e. search previous portfolios
   f. logout of the system

3. The Student Subsystem is comprised of modules to:
   a. login to the system using user name and password
   b. view portfolio proforma
   c. view portfolio teaching schedules
   d. download portfolio assignments
   e. upload portfolio assignments
   f. add certain assignment details to his/her Curriculum Vitae (CV)
   g. view Curriculum Vitae (CV)
   h. logout of the system
6.1.4 Non-Functional Requirements

Non-functional requirements are factors used to judge how the system operates. Unlike functional requirements, which describe the specific functions that the system has to deliver, non-functional requirements illustrate the quality of the system:

- **Accessibility** - The system should be accessible to any of the authorised users anywhere without requiring excessive effort. This also includes platform compatibility with all the platforms. The system is designed to be a web-based system that can be accessed through a web browser with an Internet connection. To login to the system, the user should supply a valid username with the corresponding password. After the authentication of the user’s access rights have been made, the user is signed on.

- **Availability** - The system should be readily available at any time of the day.

- **Maintainability** – The system should be easily maintained and does not demand too much effort to enhance or extend.

- **Security** - All passwords are encrypted while usernames are unique to ensure that each system user is distinct from the other. This also certifies that only authorised users can use the functionalities of the system, based on the level of privilege and access rights granted. Besides these, only the system administrator is allowed to make any changes to the internal features and structure of the system. It is crucial that the system is secure from malicious attacks.
• Usability - The system should require little effort to learn and use. Thus, it is important that the layout of the system components and workflow of the system be consistent to accelerate the familiarisation and usability process. Besides that, the auto calculation of evaluation scores will also enable higher efficiency as the required time to accomplish the task is greatly reduced.

6.2 System Design

In this section, the system flow chart, system architecture and database design are defined according to the requirements identified. The main purpose for systems design is to define components of the proposed system to ensure that the specified requirements are fulfilled.

6.2.1 System Flow Chart

The following flowchart (Figure 6.1) describes the general flow of the proposed system from the start to the end.
Figure 6.1 SEP flowchart
6.2.2 System Architecture

A three tiered architecture is selected as the architectural design for the system. The three tiered architecture, also known as client-server architecture, is a form of multi-tier architecture, where the application processes are distributed among three or more distinct computers. Each tier represents the components that serve different purposes. A given component uses the functionalities of the components in the same layer while offering services to the components in upper layers, and in turn request for services from the lower tiers. In the three-tiered architecture for the system, the application is categorised into three separate platforms that constitute the following:

- **Presentation layer**

  The presentation tier, also known as the user interface layer, is responsible for communicating with the second tier and displaying the results in a form understandable to the user. This includes some programming required to handle the graphical user interface.

- **Business logic layer**

  This layer sometimes called the application or logic tier, controls the main functionality of the application by acting as a server to the requests from the user interface, and subsequently undertakes the role of a client by requesting for services from the data layer.

- **Data layer**

  The data layer consists of database servers, which host database management systems that perform data manipulation on the information stored in the databases. This layer
maintains data independence by separating the data from the other layers in the tiered architecture, which improves scalability for future modifications.

The Figure 6.2 below shows the architecture for the system. The system is designed for access from the Internet and Intranet network systems to enable all the users to frequently update the system. In this architecture, the Apache web server is responsible for receiving http requests from the clients, and for responding by sending the requested php documents. Meanwhile, in the third tier resides the MySQL Database Server, which offers database services to the upper tier by performing data manipulation processes through handling SQL queries and returning the corresponding output.
6.2.3 Database Design

The database design includes details such as data type and size, the key constraints, as well as the relationship type between entities. From this logical design, the actual physical database structure could be generated.

Figure 6.3 SEP Database Design

6.3 System Development Consideration

6.3.1 System Environment

The final system runs on a typical web environment set up, which consists of the following components: relational database system, web server, web application, and the
user interface or browser. The system was developed and tested on a single machine or server with the following software installations as listed in the Table 6.1:

**Table 6.1 SEP System Environment**

<table>
<thead>
<tr>
<th>Item</th>
<th>Software Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Microsoft Windows XP Professional</td>
</tr>
<tr>
<td>Web Server</td>
<td>Apache server 2.2</td>
</tr>
<tr>
<td>Web Application</td>
<td>PHP 4.3.10</td>
</tr>
<tr>
<td>Database</td>
<td>MySQL 5.0 Database Server – Community Edition</td>
</tr>
</tbody>
</table>

The server has the following hardware specifications as listed in the following table, which also represents the recommended minimum hardware requirements.
Table 6.2 SEP Hardware Requirement

<table>
<thead>
<tr>
<th>Item</th>
<th>Hardware Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>Intel Pentium 4 (1.8MHz)</td>
</tr>
<tr>
<td>Memory</td>
<td>1GB DDR2 RAM at 553 Mhz</td>
</tr>
<tr>
<td>Hard Disk</td>
<td>40GB SATA</td>
</tr>
<tr>
<td>Network</td>
<td>Interface 10/100 Ethernet</td>
</tr>
</tbody>
</table>

6.3.2 Programming Language and Development Tools

This section examines the chosen scripting language and database, as well as look at the development tools that were used in the construction of the application.

6.3.2.1 PHP Programming Language

PHP is a recursive acronym for *PHP: Hypertext Pre-processor*. It is an open-source server-side scripting language that was first introduced in 1994. Since then, it has become the most popular open-source web-based programming language, used by over 6 million domains with a monthly growth rate of 15% (according to Netcraft, [http://www.netcraft.com/survey/](http://www.netcraft.com/survey/)).
Amongst the benefits of using PHP are:

1. The scripting language is very easy to learn and there is an abundance of PHP resources available on the Internet. This makes it easier to maintain and upgrade the PHP applications compared to other scripting languages such as Perl or ASP.

2. PHP works on almost any operating system. This cross-platform compatibility feature makes it easier to deploy and install completed application on existing Internet servers such as Apache, Microsoft and Netscape service solutions. Thus, it is highly suitable for today’s heterogeneous network environments.

3. PHP also has built-in supports for a wide variety of commercial, as well as non-commercial databases such as MySQL, Informix, mSQL, Microsoft SQL Server, PostgreSQL, Oracle, Sybase and also ODBC type database connection.

4. PHP supports protocols such as POP3, LDAP, SNMP, HTTP, COM, and IMAP, and also offers integration with various external libraries. This allows PHP developers to do almost anything, from generating PDF documents and creating graphic images to parsing XML documents. It is also able to work with other server-side languages, such as JAVA and COM.

5. Being an open source scripting language with wide distribution and a large community of users, PHP is very well supported. PHP bugs are found and fixed quite regularly, and the language enjoys continuous improvements to enhance its capabilities due to its huge pool of open-source developers. Most importantly, all these benefits are made available to its users without any hidden cost.
6.3.2.2 MySQL Database System

MySQL is a powerful, secure and scalable multi-threaded, multi-user relational database management system owned by the Swedish firm MySQL AB. Although small in size as compared to other commercial relational databases, MySQL is extremely fast. Perhaps the most convincing reference of MySQL implementation is the Google Search engine, which is built entirely on MySQL technology.

The main reason for using MySQL as the application database is because of PHP’s extensive built-in support for MySQL database. PHP has numerous functions available to allow developers to control and manipulate the MySQL database without having to code new procedures. This will expedite the application development as less coding needs to be done.

6.4 Development Tools

The following tools were used during the development of the Content Storyboard Application system:

6.4.1 PHP Designer 2007 Personal

This tool is available as a freeware and can be downloaded from the Internet. It is developed by MPSoftware and is an Integrated Development Environment (IDE) for PHP, designed to help ease and enhance the process of editing, debugging and analysing PHP scripts.
6.4.2 MySQL Query Browser

MySQL Query Browser is a tool for creating, executing, optimising and testing SQL queries for the MySQL Database server. It is available for free at http://www.mysql.com.

6.4.3 MySQL Administrator

MySQL Administrator is a free tool that is available from the MySQL website for administering and managing the MySQL databases. It provides database administrators with an easy to use but powerful visual interface that gives better visibility on how the databases operate.

6.5 System Testing

Human beings are susceptible to making mistakes. Even with the use of the most meticulous and sophisticated application design approach, erroneous results can never be avoided. Therefore, the final product must always be verified against the intended requirement to ensure its usability and functions acts accordingly (Ghezzi, Jazayeri & Mandrioli 1991).

The proposed application that has undergone a system test will garner greater user confidence in the system’s quality and reliability. It also gives the assurance that the
system has met its expectation and able to produce its desired outcome. Therefore, the proposed application was tested on its system’s functionality. Functional tests are conducted to ensure the functional feature provided by the application works in a manner that it is supposed to.

6.5.1 Functional Test Design

The goal of the functional test is to evaluate the system’s functionality against its specified requirements. In order to accomplish the test objectives, the black box method was used.

By using this method, the function or object to be tested is regarded as a black box in the sense that the internal structure (code and logic) of the object is not known. This approach takes the external perspective of the object where a valid or invalid input to the object should produce the correct output. In other words, this approach looks at what the program is intended to do rather than on its structure.

The black box methods allows test case to be derived from the requirements specifications. Each module’s functionality was tested with regards to its specifications (requirements) and its context (events). The output was then checked for its correctness.
In theory, there are many possible permutations of input and output combination that could be generated for the test cases. In reality, however, a thorough black box testing is close to impossible or unreasonable. The normal procedure undertaken for this test is to design a small, manageable set of test cases so as to maximise the chances of detecting a fault whilst minimising the redundancy amongst the other cases.

6.5.2 Test Procedures

Functional and interface testing were carried out for the module or for the whole system. Each and every link had been checked to make sure all the links are working correctly. Interface testing is carried out to identify that the interface works correctly and faults are not created because of interface errors. The test was conducted by ten users divided as below in Table 6.3:

<table>
<thead>
<tr>
<th>User</th>
<th>Total</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of administrator staff</td>
<td>1</td>
<td>Test the administrative staff module</td>
</tr>
<tr>
<td>Lecturer</td>
<td>3</td>
<td>Test the lecturer module</td>
</tr>
<tr>
<td>Student</td>
<td>6</td>
<td>Test the student module</td>
</tr>
</tbody>
</table>

The users were given the test case script as shown in Table 6.4 to Table 6.6. Each system’s functionalities were tested and considered as successful only if both of the assessors are satisfied with the outcome. Also, a questionnaire attached in Appendix A was distributed among the users to for interface testing.
### 6.5.3 Test Results

The final result of the application functional test results are shown in Table 6.4 to Table 6.6 below:

#### Table 6.4 Test Results of Head of Administrative Staff Modules

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login to the system using user name and password</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>View the faculty’s course portfolio</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Search for the course portfolios</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Assign specific portfolios to a lecturer</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Analyse a specific course portfolio</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Logout of the system</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

#### Table 6.5 Test Results of Lecturer Modules

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login to the system using user name and password</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>View his/her current session and semester portfolios</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Update certain portfolio contents</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Collect students’ assignments and tutorial</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Search previous portfolios</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Logout of the system</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Table 6.6 Test Results of Student Modules

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login to the system using user name and password</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>View course portfolio proforma</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>View course portfolio teaching schedules</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Download assignments</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Upload portfolio assignments</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Add certain assignment details to CV</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>View CV</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Logout of the system</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

The tables above had shown that the all of the system functionalities has passed the test. For the interface testing; the result of questionnaire is listed below:

- **Features and Functionalities**

  Based on Figure 6.4, seven of the respondents had rated the system as good and three had rated as excellent. This shows that the respondents are satisfied with the existing features and functionalities of the SEP system.
• **Familiarity of Usage**

Based on Figure 6.5, 80% of the testers rated the familiarity of usage of the system is good and the rest as satisfactory. This shows that functions of the system are not different from the manual system and have been accepted by the users.
• **Attractiveness of Interface Design**

![Figure 6.6 Attractiveness of Interface Design](image)

Based on Figure 6.6, 40% of the respondents have rated the interface as good and 60% as satisfactory. From this it is depicted that this system need to improve the interface design to meet the user requirements.

• **Acceptance of the prototype**

Based on Figure 6.7, all respondents have rated the SEP as excellent, therefore the objective of developing a prototype system to manage the course portfolio is achieved.
Based on Figure 6.8, all respondents have rated the SEP as excellent, therefore the objective of developing a prototype system to manage the course portfolio is achieved.

- Additional Features and Functions

Based on Figure 6.8, 90% of the respondents had agreed to include more features and functions for the E-Portfolio. Some of the features suggested are the inclusion of electronic discussion board feature more analysis graph tools. This suggestion have been taken into consideration and will incorporate as the future enhancement.
6.6 Screens Capture

6.6.1 Login Screen

All users are required to login in order to use the application. The user name and password are created by the system administrator.
6.6.2 Administrative Staff Screen

![Administrative Staff Screen](image)

**Figure 6.10 Administrative Staff Screen**

The above screen shows the page that the administrative staff will see after a successful login. This screen gives the administrator staff four functions to perform:

- View and search the **Current Portfolios**.

- View and search the **Previous Portfolios**.

- **Assign Portfolio** to lecturer.

- Analysing course portfolio by selecting **Portfolio Analysis Engine**.
Figure 6.11 Current Portfolios screen

Figure 6.11 above, shows the details of current session and semester course portfolios. It displays the course id, course name, lecturer id and lecture name. By clicking the course id, the system will display the status and contents of course portfolio as shown in Figure 6.12
The screen in Figure 6.12 shows the contents status of selected course portfolio. It displays the portfolio semester and session. The course id, course name, lecturer id and lecture name are also displayed. The Status column shows which contents that have been uploaded by lecturer as well as the portfolio details.

![Assign Portfolio](image)

**Figure 6.13 Assign Portfolio**

The screen in Figure 6.13 shows how the administrative staff can assign a portfolio to a lecturer. He/she needs to select the course ID from the drop list and the course name will be displayed. Then the staff needs to select the lecturer ID and the lecturer’s name will be displayed. Then the ‘Assign’ button must be pressed to assign a specific portfolio to the specific lecturer. Once the Assign button has been pressed, a pop message will be displayed to indicate the successful of the operation. Then the Administrative Staff Screen in Figure 6.10 will be displayed.
The Portfolio Analysis Engine in Figure 6.14 will help the administrative staff to analyse the data of specific course portfolio. After selecting the course ID from the drop list, the course name and all the sessions and semesters in which this course has been taught will be displayed. The administrator can then go further by selecting the link of the Session to be analysed. Moreover, the administrator can view the statistic of all Sessions for the selected course ID.

When selecting a specific session link in Figure 6.14, the details of the portfolio will be displayed such as the course name, course ID, lecturer’s ID, lecturer’s name, course session and semester. The administrative staff has two analysis modes – either text and/or graph – as displayed in Figure 6.15.
In the text mode, five options are available:

1- General Statistic option, displays the number of students that took the course as well as the number of successes and failed students.

2- General statistic by gender option, displays the total number of males and females students. Also, it displays the number of success and fail males and females students.

3- Grade option, displays the total numbers of students that score the specific grade.

4- Grade statistic by gender option, displays the total numbers of Males and females students that score the specific grade.
5- By selecting the **All** option in Figure 6.16, the screen below will be displayed to show the general statistic, general statistic by gender, grade and grade statistic by gender.

![Figure 6.16 All Option Selection](image)

The general statistic by gender and grade by gender will help the management to know the influence of gender in academic achievement and performance in a specific course. Moreover, it will help to decide if the course will be conducted in next semester or not depending on the numbers of male/female.
On the other hand, in the graph mode, only two options are available:

1- The screen below shows the grade histogram option. Its displays the histogram of grades scored by students for selected portfolio. Also, the number of students that scored certain grade is displayed.

2- The screen in Figure 6.18 shows the grade histogram by gender option. Its displays the histogram of grades scored males and females students. Also the number of males and females that scored certain grade is displayed.
6.6.3 Lecturer Screens

Figure 6.18 Grade Histogram by Gender Option

Figure 6.19 Lecturer Main Page
The screen in Figure 6.19 shows the page that the lecturer will see after a successful login. The lecturer will be able to see the current session and semester portfolio. The previous portfolio will also be displayed. The lecturer can select any course ID link from the current portfolio to be able to upload the portfolio contents as displayed in Figure 6.20.

The screen below shows the contents of course portfolio that must completed by the lecturer. Also the lecturer can view the list of student that taking the course. In order to upload any contents, lecturer can select the content link in the screen to perform the task of uploading. For the security purpose the link for Exam Question and Exam answer schema will not be activated until the final exam is finished. Once the exam is done, lecturer can use the link to upload the exam questions and answers.

![Portfolio Contents Screen](image.png)

**Figure 6.20 Portfolio Contents Screen**
The screen below shows the assignments and tests uploaded by the lecturer. The lecturer can update and delete the assignments. In order to upload an assignment or a test, the lecturer can press the ‘ADD’ button. A pop up window will then appear to allow the lecturer to enter the details of the assignment or test. The lecturer can also collect the students’ assignment answers.

![Assignments and Tests Screen](image)

**Figure 6.21 Assignments and Tests Screen**
6.6.15 Student Screens

Figure 6.22 Student Main Screen

The above screen shows the page that the student will see after a successful login. The student can see the current and previous, session and semester portfolios that he/she is enrolled in. Also, the student can also create a CV, containing the names and details of the assignments completed, as well as other personal data. The create CV option was requested by student during system test, in order to help them applying for any kind of training or job on the move. By selecting the course id, the student can see the details of selected portfolio as it’s shown in Figure 6.23.
In the Figure 6.23, the student can preview the course proforma and teaching schedules. By selecting the Assignment link, the student can download and upload course assignments.

Figure 6.23 Course Details Screen

Figure 6.24 Student Assignment Submission Screen
In the Figure 6.24, the assignment name, description and mark that have been uploaded by the portfolio lecturer are displayed. If the student wants to download the assignment, the student required to select the assignment name link. In order to upload the assignment solution, the student can select the submit link. If the assignment submitting is done successfully, the name of assignment will be added to Submitted Assignment table and the Done status will be displayed.

The Submitted Assignments table will help the student to keep tracking of submitted assignments. Also, the student has the option to add the details of assignment to his/her CV. The CV column indicates if certain assignment details have been added or not to CV. The details of submitted assignment are course code, course name, session, semester and the description of assignment. The Figure 6.30 below show sample of CV created by the system.

Figure 6.25 Student CV Screen
6.7 Summary

In this chapter, the design of SEP system has been discussed. The user requirements have identified based on data collected. The functional requirements of the system have implemented. Also the testing of the system has been reported.
Chapter 7: Conclusion

The chapter discusses the outcomes of this entire research, its limitations, and last but not least, the future expectations of this research.

7.1 Outcomes of the Research

Based on the research objectives stated earlier, here are the achievements obtained from the research:

The first objective was successfully achieved, which is to understand the present situation in using course portfolio in a faculty. The literature review in Chapters 2, support and enrich the knowledge of the author in understanding what course portfolio all about is. This knowledge was the base pivot when the author conducting researches in the case study in Chapter 3. It’s found that the Quality Management and Enhancement Centre (QMEC) is responsible for setting the standards and creating the contents of course portfolio. The FCSIT is following and implementing course portfolio sited by QMEC.

The next objective is to identify the processes involved in preparing a course portfolio in FCSIT. This objective has been highlighted clearly in Chapter 3. The course portfolio life cycle has been explored as well as the main roles of the main stakeholders have been stated. In addition to that, the documents used by the FCSIT in managing the course portfolio have been captured and explained.
The third objective was to identify the problems facing the initialisation of a course portfolio and carry out its implementation. The analysis of the data collected from observation, documents and interviews, it has been discovered that the current system being used in FCSIT for course portfolio is manual. The current system suffers from various setbacks such as storage problem, information retrieval problem, paper disorganisation and difficulty in analysing the course portfolio data.

The fourth objective was achieved successfully which is to develop a web-based system to automate a course portfolio and its processes. An Smart Electronic Portfolio (SEP) has been developed to provide a better course portfolio administration and management. Also the system supports the administrative staff with an analysis tool, which helps to analyse the data of the course portfolios. By using SEP, lecturers are able to upload the contents of course portfolio and collect the students assignments electronically. The platform and framework of the system are well defined. Any enhancement and extra integration can be accomplished without much difficulty.

7.2 Limitations of the Research

There were few constraints encountered in completing the research work. The first constraint is that the contents and forms used to review and audit the course portfolios were all in Malay language and its should be translated to English language. To overcome this constraint, the documents have been sent to my colleague in the Faculty of Languages and Linguistics, University Malaya for translation. His help are much appreciated.
Learning and using the programming language and system developing tools mentioned in Chapter 6, was the second constraint. The author has been enrolled in a training programme for one month to get familiar with programming language used to develop the system.

7.3 Future Works of the Research

Some of the future research works for Smart Electronic Portfolio (SEP) that can be considered include:

1.- Administrative staff’s tasks can be further enhanced with extra features in the system such as analytical tools, data mining and other relevant reports and database backups.

2- An interactive tool can be added to enrich the online discussion among the users of the system. The ideas and thoughts exchanged among them can help improve and enhance the use of the system.

3- The user interface of the system can be further enhanced to be more attractive, impressive and interactive when the web portal is converted to a real-time system.

7.4 Thesis Summary

A portable web-based, database application, named Smart Electronic Portfolio (SEP) was developed. A thorough study and implementation of an online SEP had been conducted. The SEP main objective is to facilitate the managing and creating the contents of
FCSIT course portfolio. An investigation on the course portfolio concept, contents and processes had also been conducted.

Overall the Smart Electronic Portfolio has been successfully built and has achieved and fulfilled the objectives and requirements. A web interface to the application was provided for student, lecturer and an administration staff. For lecturer, facilities for creating course portfolio electronically (store, access, update). Moreover, the application facilitate for lectures the implementation standards and outcomes, measuring results, and holding educational institutions accountable for student learning. For the administrative staff, the application gives them the ability of auditing, analyzing and tracking the lecturers course portfolios. For student, facilities for downloading and submitting assignment electronically and creating Curriculum vitae online.
Functionality and Usability

1. Do the system functions work accordingly?
   a. Excellent  b. Good  c. Satisfactory  d. Below average  e. Poor

2. Is the system familiar to use?
   a. Excellent  b. Good  c. Satisfactory  d. Below average  e. Poor

3. Is the interface design attractive and easy to use for your operation?
   a. Excellent  b. Good  c. Satisfactory  d. Below average  e. Poor

4. Overall how do you find the prototype?
   a. Excellent  b. Good  c. Satisfactory  d. Below average  e. Poor

5. Would you like to include more features and other functions to the system?
   a. No
   
   b. Yes

   If yes, please comment
   __________________________________________________________
   __________________________________________________________
Appendix B: source code for creating student CV

```php
<?php
session_start();
ob_start();
include_once('..//db_login.php');
include_once('..//function.php');
require_once("phprtflite/rtf/Rtf.php");
if(!session_is_registered(userID)){
  header("location:../index.php");
}

////////////////////////////////////////////////////

//get student CV details
$name=$_SESSION['userName'];//student name
$Mno=$_SESSION['userID'];// student matric no
$sql="SELECT * FROM t_student
WHERE std_matricno='$Mno';
$result=mysql_query($sql) or die('Error, query failed');
$row = mysql_fetch_array($result);
$id=$row['std_Id'];
national=$row['Std_national'];
$gender=$row['std_gender'];
$email=$row['Std_email'];
$address=$row['std_address'];

```

```
/// CV format
$parHead = new ParFormat('center');
$parHead->setSpaceBefore(3);
$parHead->setSpaceAfter(15);
$parSubHead = new ParFormat('left');
$parSubHead->setSpaceBefore(30);
$parBlack = new ParFormat();
$parBlack->setIndentRight(5);
$parBlack->setBackColor('#000000');
$parBlack->setSpaceBefore(10);
$fontHead = new Font(12, 'Arial');
$fontSmall = new Font(3);

////////////////////////////////////////////
$rtf = new Rtf();
$sect = &$rtf->addSection();
$s=" <br>Name:               $name
    Gender:             $gender
    ID:                 $id
    Nationality:        $national
    Email:              $email
    Address:            $address ";
$sect->writeText('Curriculum Vitae', new Font(14, 'Arial'), $parHead);
$sect->writeText('PERSONAL INFORMATION', $fontHead, $parSubHead);
$sect->emptyParagraph($fontSmall, $parBlack); // black line
$sect->writeText($s, new Font(12), new ParFormat('left'));
$sect->writeText('ACADEMIC QUALIFICATION', $fontHead, $parSubHead);
$sect->emptyParagraph($fontSmall, $parBlack);//black line

$sect->writeText('PROFESSIONAL AFFILIATION / MEMBERSHIP', $fontHead, $parSubHead);
$sect->emptyParagraph($fontSmall, $parBlack);//black line

$sect->writeText('LEADERSHIP', $fontHead, $parSubHead);
$sect->emptyParagraph($fontSmall, $parBlack);//black line

$sect->writeText('AREA OF EXPERTISE', $fontHead, $parSubHead);
$sect->emptyParagraph($fontSmall, $parBlack);//black line

$sect->writeText('ACADMIC PROJECTS', $fontHead, $parSubHead);

///////////////////////////////////////////
//create table

///////////////////////////////////////////
$table = &$sect->addTable();

//table header
$table->addRows(1);
$table->addColumn(3);
$table->addColumn(3);
$table->addColumn(3);
$table->addColumn(3);
$table->addColumn(3);

$parHeaderCell = new ParFormat('center');//header backgroud
$parHeaderCell->setBackColor('#cccccc');//gray

$cell = &$table->getCell(1, 1);
$cell->writeText('Course Code', new Font(12, 'Arial'), $parHeaderCell);
$cell = &$table->getCell(1, 2);
$cell->writeText('Course Name', new Font(12, 'Arial'), $parHeaderCell);
$cell = &$table->getCell(1, 3);
$cell->writeText('Session', new Font(12, 'Arial'), $parHeaderCell);
$cell = &$table->getCell(1, 4);
$cell->writeText('Sem', new Font(12, 'Arial'), $parHeaderCell);
$cell = &$table->getCell(1, 5);
$cell->writeText('Description', new Font(12, 'Arial'), $parHeaderCell);

////end table header

//fill the table with student data

$parCell = new ParFormat('left');//cell backgroud
$parCell->setBackColor('#ffffff');

$sql="SELECT Sub_code,Sub_name,Subm_descrip,Ass_subID
FROM t_submaterial,t_stdassignment,t_subject,t_assigningsub
WHERE Stdass_stdNo='$Mno' and t_submaterial.Subm_ID=t_stdassignment.Subm_ID and t_assigningsub.Assign_ID=t_submaterial.Assign_ID and Sub_code =Ass_subCode and stdAss_CV='1'';
$result=mysql_query($sql) or die('Error, query failed ');

$counter=2;
//draw the rest of table

while($row = mysql_fetch_array($result)){

$subcode=$row['Sub_code'];
$subname=$row['Sub_name'];
$session=session($row['Ass_subID']);
$sem=sem($row['Ass_subID']);
$descrip=$row['Subm_descrip'];

$table->addRows(1);  
$cell = &$table->getCell($counter, 1);  
$cell->writeText($subcode, new Font(12, 'Arial'), $parCell);  
$cell = &$table->getCell($counter, 2);  
$cell->writeText($subname, new Font(12, 'Arial'), $parCell);  
$cell = &$table->getCell($counter, 3);  
$cell->writeText($session, new Font(12, 'Arial'), $parCell);  
$cell = &$table->getCell($counter, 4);  
$cell->writeText($sem, new Font(12, 'Arial'), $parCell);  
$cell = &$table->getCell($counter, 5);  
$cell->writeText($descrip, new Font(12, 'Arial'), $parCell);

$counter++;

}


//print student CV
$rdf->prepare();
$rdf->sendRtf('Cv');
?>
<?php
include_once('C:\web\webserver\htdocs\src\jpgraph_bar.php');
include_once('..//db_login.php');
include_once('..//function.php');
include ("src/jpgraph.php");
include ("src/jpgraph_bar.php");
include ("src/jpgraph_line.php");

$ID=$_GET['ID'];
$type=$_GET['type'];

//get course portfolio analysis data
$sql="SELECT *
    FROM t_analysis
    WHERE Assign_ID='$ID' ";
$result=mysql_query($sql) or die('Error, query failed');
$row=mysql_fetch_array($result);
// create and fill Gender array
$gender=array(
    "M" =>array(0,0,0,0,0,0,0,0),
    "F" =>array(0,0,0,0,0,0,0,0)
);

$gender=fill($gender,$row); //function.php

//type=1 means general Grade Histogram
//type=2 means general grade Histogram by gender

if($type==1)
{
    $ydata=mergeOne($gender);
    $graphName='Grade Histogram';
    $gbplot =new BarPlot($ydata);
    $gbplot->SetFillColor('orange');
    $gbplot ->value->SetFormat( " %d");
    $gbplot->value-> Show();
    $gbplot->SetWidth(1.0);

    // create line plot
    $glplot=new LinePlot($ydata);
    $glplot->SetColor("red");
    $glplot->SetWeight(2);
    $glplot->SetBarCenter();
}
else
{
    $yMaledata=fillYMdata($gender);
    $yFemaledate=fillYFdata($gender);
    $graphName='Grade Histogram (Gender)';
$b1plot = new BarPlot($yMaleData);

$b1plot->SetFillColor( "orange");
$b1plot->value->SetFormat( " %d");
$b1plot->value->Show();
$b1plot->SetLegend("Male");

$b2plot = new BarPlot($yFemaleData);
$b2plot->SetFillColor( "blue");
$b2plot->value->SetFormat( " %d");
$b2plot->value->Show();
$b2plot->SetLegend("Female");

// Create the grouped bar plot
$gbplot = new GroupBarPlot(array($b1plot,$b2plot));
}

// Create the graph
$graph = new Graph(550,250,"auto");
$graph->SetScale("textint");

// set graph name and font
$graph->title->Set($graphName);
$graph->title->SetFont(FF_FONT1,FS_BOLD);

// set margin
$graph->img->SetMargin(25,150,40,50);
// set X title
$graph->xaxis->title->Set("Grade");
$graph->xaxis->title->SetFont(FF_FONT1,FS_BOLD);

// set xaxis text label
$a= array('A','A-','B+','B-','C+','C','F','");
$graph->xaxis->SetTickLabels($a);
$graph->xaxis->SetLabelAlign('center','center');
$graph->xaxis->SetLabelMargin(5);
$graph->yaxis->scale->SetGrace(5);

// Adding a legend
$graph->legend->Pos(0.05,0.5,"right","center");

// Add the plot to the graph
$graph->Add($gbplot);
if($type==1)
    $graph->Add($glplot);

// Display the graph
$graph->Stroke();
?>
Appendix D: Source Code For Downloading Students Assignments As Compressed File

```php
<?php

session_start();
ob_start();
include_once('..//db_login.php');
include_once('..//function.php');
if(!session_is_registered(userID)){
  header("location:../index.php");}
if(isset($_GET['id']))
{
  $id   = $_GET['id'];
  //select file to download
  $query = "SELECT Stdass_fileName
             FROM t_stdassignment
             WHERE Subm_ID = '$id'";
  $result = mysql_query($query) or die('Error, query failed');
  //get the file names
  $file_names = fillArr($result);
  $archive_file_name=$_GET['Assname'].'.zip';
  zipFilesAndDownload($file_names,$archive_file_name,$StdAss_path);
}
?>
```
function zipFilesAndDownload($file_names,$archive_file_name,$file_path)
{

    //create the object
    $zip = new ZipArchive();

    //create the file and throw the error if unsuccessful
    if ($zip->open($archive_file_name, ZIPARCHIVE::CREATE )!==TRUE) {
        exit("cannot open <$archive_file_name>
    );
    }

    //add each files of $file_name array to archive
    foreach($file_names as $files)
    {
        $zip->addFile($file_path.$files,$files);
    }
    $zip->close();

    //then send the headers to force download the zip file
    header("Content-type: application/zip");
    header("Content-Disposition: attachment; filename=$archive_file_name");
    header("Pragma: no-cache");
    header("Expires: 0");
    readfile("$archive_file_name");
    exit;
}
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