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ASCERTAINING FACTORS MOTIVATING USE OF DIGITAL LIBRARIES AND FORMULATING USER REQUIREMENTS USING ZACHMAN FRAMEWORK

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ABSTRACT

This paper describes the framework used in a study to formulate the requirements for the design and implementation of a collaborative digital library (CDL) for project-based learning. The CDL has been conceived to support secondary students information needs in conducting research projects. The study uses the Zachman Framework for Enterprise Architecture for the approach to investigate the initial requirements. The first artifact addressed in the framework - motivation (Why things are done) - is highlighted in this paper. Motivation in this work refers to major goals, curricular and programmes that are significant to the digital library relative to motivation. This includes the readiness to use the digital library, willingness to participate in content development and management, and the success factors. Using multiple data-gathering techniques, the study identifies the motivating factors that support the plan for realisation of the CDL. It outlines the vision statement, goals and objectives needed to define the strategic direction for the CDL project as perceived by the planner; the business plan or context to use the CDL as viewed by the owner; and the mandatory functional requirement of the digital library expressed as behavioural objectives as viewed by the designer.

Keywords: Collaborative digital libraries; Collaborative resource development; User needs assessments; Project-based learning; Zachman Framework for Enterprise Architecture; Digital libraries for education; Malaysia

INTRODUCTION

Digital libraries serve communities of people and are created and maintained by and for people. All efforts to design, implement and evaluate digital libraries must be rooted in the information needs, characteristics and contexts of the people who will or may use those libraries (Marchionini, Plaisant and Komlodi, 2002). While there are several models for building and maintaining digital libraries, a model that

involves participants who have varying strengths, needs, experiences, and interests should make a significant difference in the design, development, and utility of digital libraries for education (Giersch et al, 2004). Development of a model or models that describe participant involvement should enhance the likelihood that multiple users can be effectively involved in all facets of the digital libraries. Therefore, to make effective users adaptations, research must involve finding out what the potential users already know, what their misconception and problems might be and what they would be interested to do and learn in a digital library environment. In order to increase the acceptance and relevance of a digital library contents to users' needs, researchers should concentrate on user requirement analysis to discover expectations and content demands to incorporate into a digital library (Thong, Hong and Kar, 2004).

RELATED WORK

Users' involvement in digital library design has been a continuing topic of interest in the digital library community and a focus on user needs is central in many studies. There is a general acknowledgement that incorporating user input into the design and development of digital libraries will result in the construction of better systems (Theng et.al, 2001; Bishop, Van House, & Buttenfield, 2003; Giersch et al, 2004). Incorporating a work-oriented perspective, a technique that focuses directly on the user community being served, Levy and Marshall (1996) examined the information needs, information seeking behaviour and the tools used to support these functions using ethnographic studies that observe the work a community is engaged in. Van House (1995) discussed user needs assessments and identified three methodology areas which are "predecessor" in nature to digital library research: library evaluation with its focus on users' needs as the basis for evaluation, user-centred system design with its incorporation of user needs into system design, and usability analysis with its feedback methods.

Various frameworks for the design, development, evaluation and interaction of digital libraries have been conceptualized and described in digital library research. Literature emphasised the importance of a holistic approach to examine networked information services such as digital libraries as examining a single view or dimension of such as services are likely to be limited in their utility. Levy and Marshall's (1996) framework highlights three crucial characteristics of libraries: document, technology, and work (which involves research and service). Moen and McClure (1997) identified a framework of five interacting dimensions in Government Information Locator Service (GILS): policy, users, technology, contents, and standards and policy. The evaluation framework also includes three

perspectives, representing the "views" of the stakeholders in the GILS: users, agencies, and the government. Marchionini and Fox (1999) identified four dimensions of digital library development: community, technology, service and content. Soergel (2002) argues that a framework for digital library research and development is needed to provide a perspective on existing research and as a way of providing "a structured vision for the development of new ideas". Marcos (2004) introduced 5S and formalisms for streams, structures, spaces, scenarios, and societies — as a framework for providing theoretical and practical unification of digital libraries

In order to identify what is required of a digital library in a Malaysian context, a sound methodology is needed to establish an understanding of the digital library entire structure. A multi-faceted information services such as digital libraries may be examined along different dimensions and from different perspectives or views and it is noted that the various dimensions in the frameworks and the multiple data collection techniques indicated in earlier studies do not exist in isolation from each other. As such, this research adopts multiple data collection techniques that do not only examine the various dimensions from a variety of perspectives, but also provide for the relationship of these dimensions in a framework. There is a need to identify potential stakeholders, their involvement and roles in the digital library, their attitude towards the initiative, their perception of its potential use and how it fits within the curricular goals in general and a school subject in particular. In order to do this, a digital library enterprise is required, which is derived and based on empirical data and stand up to conceptual reasoning. The following section describes the framework used in this study to model the digital library architecture This research has chosen the Zachman Framework for Enterprise Architecture for the approach to investigate the initial requirements and define the digital library organization, processes, technology and information flows.

USING ZACHMAN APPROACH TO FORMULATE THE DIGITAL LIBRARY REQUIREMENTS

The Zachman Framework (www.zifa.com) is a logical structure for classifying and organising the descriptive representations of an Enterprise that are significant to the management of the enterprise, and to the development of the enterprise' systems. This framework is used to formulate the architecture for the CDL that positions and ensures the standards for creating the information environment exist and that they are appropriately integrated. The framework provides the descriptive representation of an enterprise, in different dimensions, and each dimension can be perceived in different perspectives. In this framework, the architecture is described across two

independent aspects, the rows represent the views (perspectives) of five different types of stakeholders (planner, owner, designer, builder and sub-contractor) and the columns represent different aspects (dimensions) of the architecture (data, function, network, people, time and motivation). The points of intersection between the rows and the columns (i.e. between the views and the aspects) form cells. Each of these cells, also known as artifacts, holds important information of the enterprise that needs to be understood and explicitly declared. The framework explicitly highlights the need to involve the stakeholders of the system in the development of the architecture to ensure that it meets their needs and ideally this practice is what the researchers want to follow. Throughout this research, Zachman Framework is used as a basis to investigate the existing stakeholder's conditions and environment that would ensure the reception of a CDL for schools use.

In the context of this study, the contextual, conceptual and logical systems architecture of the digital library from a top-level perspective are defined. Specifically, the study ascertains the combined view of the planner, the owner and the designer of Rows 1, 2 and 3 of the Zachman Framework and positions it in the context of designing the requirements of the CDL. Only the top three layers, namely the scope, business model and the system model are discussed in this paper. Scope describes the system's vision, mission, context, boundaries, architecture and constraints. For the digital library enterprise in this research, the owner of (or the person most interested in) the scope model in row 1 is the researcher, who plans what the system is to do. The planner is concerned with positioning the digital library in the context of its environment. Business model defines goals, strategies, structure and processes that are used to support the mission of the digital library enterprise. This row is also referred to as the concept row, and the owner of the business model in row 2 is the educational community who owns the digital library. The owner is interested in the digital library's deliverable and how it will be used. System model contains system requirements, objects, activities and functions that implement the business model. The system model states how the system is to perform its functions. This row is also referred to as the logical row. The owner of the system models in row 3 is the researcher who designs the requirements of the digital library. The columns divide the focus of attention into six areas: Motivation, Data, People, Process, Place and Time. These artifacts mean any kind of representation, model or diagram, which support the intention of each cell in the Zachman Framework. These perspectives help ensure that everything relevant to the digital library enterprise is covered are used as a basis to identify the required research variables and to design the necessary research instruments.

THE STUDY

This research adopts a multi-method approach and aims to examine the existing stake holder's conditions and environment that would ensure the reception of a CDL for schools use, and develop a requirement matrix, as well as test the CDL prototype. This study uses the case study approach and a focus group within the case study sample. A single selected urban secondary school in Malaysia is chosen for the following reasons: (a) The school is willing to participate in the study; and (b) the school provides Internet connections and is situated near numerous cyber cafes, putting the stakeholders in an ICT rich environment. It was considered that respondents would be, for all practical purposes, fairly representative of the Form 2 and 3 students population who are conducting their school project in a typically urban environment.

Since the research needs to examine the possible determinants related to stakeholders' condition and reception of the CDL, the researchers have selected and utilised one or more methods on the basis of satisfying the information needs of the study. For each method, Zachman Approach is used as a guide to formulate the questions in each research instrument, which within it encompasses both quantitative and qualitative measures, so that they adhere and are within the scope of What, How, Who, When, Where, and Why components in the Zachman Framework. Gathering qualitative data is conducted at the various cells of the framework. One or more of the research techniques collect data related to each of the components in the Framework.

Motivation (Why things are done) in this work refers to major goals (or objectives or strategies), curricular and programmes that are significant to the digital library relative to motivation. This includes the readiness to use the digital library, willingness to participate in content development and management, and the success factors. Data gathering techniques for this component include:

a) Survey questions related to students' ICT literacy, their motivations for gaining access and their perceptions of its potential; readiness and reception to participate in the building of the digital library as content developers, their motivation and willingness to collaborate and share digital resources, as well as their understanding of their role in the CDL environment. Participation in the survey is voluntary, and a total of 397 students were present at the time the questionnaire was administered. The 397 Secondary 2 and 3 students participated in the survey consisted of 53.9% (214) boys and 46.1% (183) girls.

They come from various academic backgrounds, in terms of academic performance and parents' education.

b) Focus group sessions with students probing further their conception of digital libraries, their motivations for gaining access and their perceptions of its potential; their behaviour when searching for information and their sources of information explore the issues involved in establishing a facility to provide access to web resources in schools. Out of the 397 survey respondents, a total of 30 students who expressed willingness to participate in the digital library initiative as content providers were chosen as subjects for the interview. These students form the focus group in this study.

c) Interviews with teachers to ascertain their willingness and readiness to participate in the digital library initiative as content managers, teacher's expectations and the perceived values of web resources and digital libraries. Six History subject teachers, teaching the Secondary Year 2 and 3 students were included in the teacher interview. History subject teachers are chosen because from initial analysis, the survey reveals that the sample highly use the Internet to get information for their History project.

d) Site observation involved a series of visits to the school to observe specific environment of the CDL implementation. Through interviews with the school administrators (Principals, Academic Assistant, Afternoon Supervisor and ICT Coordinator) as well as observation of the school's ICT environment, the researchers collected data on Internet penetration, computer and networking facilities, ICT integration in the curriculum, ICT usage by teachers and students in the school, ICT policy and school library facilities. The site visits provide detailed understanding from the school administrators' perspectives of the implementation issues, related to ICT facilities and usage. It also explores relevant issues and discuss experiences and visions for the digital library developments and strategic issues involved in establishing a sustainable facility such as partnership, ownership and management

Together these data gathering techniques provide quantitative and qualitative data that illustrate the needs and expectations of the stakeholders involved in the CDL initiative.

MOTIVATION: WHY THE DIGITAL LIBRARY IS NEEDED

Why (Motivation) cell of Zachman describes the motivation of the people and the digital library that support the plan for realisation. This reveals the reasons for creating the digital library, as well as the establishment of goals, objectives and business plan of the digital library. The stakeholders' concern is the primary focus of

the Why cell in each row. Findings from the survey, focus group interviews and site observation assumes that in general, the educational community in this case study is ready to collaboratively build the digital library as reflected by their digital library readiness score of >60% (indicated being ready). The motivating indicators that support the plan for realization of the digital library are evidenced and detailed by the following findings:

a) ***ICT readiness as indicated by students ICT individual differences*:** The findings indicated that students are ready to utilize digital libraries as computer ownership is high (89.2%, 354) and all respondents in the sample indicate having used computers. A high majority (95.0%, 377) has access to the Internet and 75.3% (299) respondents indicated having Internet home account. The students in this survey can be described as "Internet-savvy"; many of these students have been online for more than five years and they are technologically-elite and literate. A total of 32.7% (130) have an online usage experience of 3-4 years, whereas 18.4% (73) have more than 5 years. The students sampled are also frequent users of the Internet with 30.2% (120) logging on everyday, 8.8% (35) at least every alternate day and 24.9% (99) at least once a week (Table 1). Students report that their primary access to the Internet access is at home, and that is the place they most frequently go online. This equated to about 84% of the total respondents having access to the Internet from home.

Table 1: Students' Internet Experience

Internet Experience	Frequency	Percentage	Mean & Std. Dev.
Length of Use			
○ Less than 6 months	37	9.3	
○ About one year	59	14.9	3.38 ± 1.24
○ About two years	78	19.6	(n=377)
○ About 3-4 years	130	32.7	
○ More than 5 years	73	18.4	
Frequency of Use			
○ Never	20	5.0	
○ Less than every 3 months	35	8.8	
○ At least every 3 months	28	7.1	4.93 ± 1.81
○ At least every month	60	15.1	(n=397)
○ At least once every week	99	24.9	
○ At least every 2 days	35	8.8	
○ Every day	120	30.2	

b) Digital readiness as indicated by students' awareness and usage of digital resources, and strong preference for digital resource: The survey indicates that high proportions of students feel comfortable with digital resources (Table 2), use them substantially (Table 3), and are relatively well equipped in terms of searching for and sharing the resources (Table 4). Overall, there is a strong preference for digital sources. This preference is reinforced by the ease of access to these resources, as indicated by a few students who wrote that Web resources are the best option for obtaining fast information. However, students' usage of Malaysian educational websites is limited to only specific sites as many students are not aware of the websites as well as the services and resources they have (Table 5).

Table 2: Responses Regarding Students Internet Experience (n=377)

No	Statements	Frequency	Percentage
1	I always find what I wanted when I search the Internet	326	82.1
2	I acquire my I acquire my web skills while using the Internet	313	78.8
3	I have fun while using the Web	361	90.9
4	I find it so easy to use the Internet to get information	298	75.1
5	I have sometimes been frustrated while using the Web	216	54.4
6	I need more help from my teacher on using the Internet	143	36.0
7	My teachers encouraged me to use the Web	207	52.1
8	My teachers discouraged me from using the Web	51	12.8

Table 3: A List of School-related Use of the Internet

The online students in this study performed the followings:
Used the Internet for school assignments
Used the Internet as the major source for their most recent school project
Discussed / talked about school work online
Find information, read online materials to prepare themselves for quizzes
Downloaded sample essays, notes, examination questions
Created a Web page for a school project
Used a Web site set up by school or a class

Table 4: Methods of Sharing or Exchanging and Finding Information Found on the Internet (n=377)*

Sharing / exchanging information	*f*	Finding information	*f*
E-mailing the URL of websites	109	Use search engine that appears when I click the search button of my browser	143
Inform other via chat room	95	Use my favourite search engine	168
Create links to the websites	10	Links from the home page I usually use	47
Click to the "send to a friend" button of the website	42	Browsing from Internet directory such as Yahoo! and MSN	19
Others: Communicate with friends via other means : the telephone, SMS and word-of-mouth	63	Others: Not indicated by students	0

* Excluding 20 Internet Non-users

Table 5: Students' Experience in Using Specific Web Portals and Digital Libraries (n=377)

Web Portals and Digital Libraries	Yes	
	Frequency	Percentage
Tutor.Com	96	24.2
Cikgu.Net	32	8.10
Any Online Newspaper	100	25.2
Any Government Website	112	28.2
Any Education Website	150	37.8
Any Entertainment Website	239	60.2
Any Library Website	22	5.5
Any Web Directory (e.g. MSN, Yahoo!)	275	69.3
Other Educational Web Portals		
• KakakTua	4	1.1
• Epelajar	2	0.5
• Student.com.my	5	1.3
• GetCyberEd	2	0.5
• MySchoolNet	8	2.1

c) ***Acceptability to use digital libraries as indicated by the high responses of students who feel that there is a need for digital libraries for school projects and this would definitely benefit them:*** Digital libraries have been accepted in a very favourable way by the students. They perceive digital libraries as useful (Table 6). In the survey, it was apparent that users' concerns and priorities were centred on getting the relevant information and participating in the digital library community as content providers. Primary findings of the users study revealed the need for search and publishing tools in the digital library, as well as the need for a community developed around the digital library. The survey revealed that students not only desired a digital library where they could find resources for school projects but also were also willing to be design partners and being part of the community within which they could contribute contents and communicate with others.

Table 6: Usefulness of a Digital Library and Willingness to Participate

	VU	U	SU	NU	TNU	Mean
A digital library of history projects submitted by students, which contains resources on personalities, historical buildings, places and events be useful for project work	38 9.6	222 55.9	137 34.5	0 0.0	0 0.0	3.75 0.616
	VW	W	SW	UW	TU	Mean
I am willing to participate in such a project if given the chance	18 4.5	240 60.5	31 7.8	108 27.2	0 0.0	3.42 0.939
I am willing to produce and submit my project work to such a portals.	16 4.0	241 60.7	44 11.1	96 24.2	0 0.0	3.45 0.902
I am willing to be a content provider to a portal of historical projects.	20 5.0	238 59.9	46 11.6	93 23.4	0 0.0	3.47 0.906
I am willing to be trained on how to publish my project in the portals.	0 0.0	191 48.1	114 28.7	92 23.2	0 0.0	3.25 0.808

Very useful (VU) – 5; Useful (U) – 4; Somewhat Useful (SU) – 3; Not useful – 2; Totally Not Useful (TNU) – 1Very willing (VW) – 5; Willing (W) – 4; Somewhat Willing (SW) – 3; Unwilling (UW)– 2; Totally Unwilling (TU) – 1

c) ***Strategic readiness as indicated by the school's comprehensive strategic master plan for the integration of ICT-mediated learning in education and training***: This plan includes the vision, mission, values, objectives, strategies, and timeframe of the school's ICT initiative. The plan, initiated by the Curriculum Senior Assistant and the ICT coordinator, also outlines the appropriation budget, borne by both the government and the Parents Teachers

Association (PTA), to cover costs related to hardware and software, connectivity and upgrading of the school's computer network, development of educational software, software licenses, maintenance, staff training and development. The strategic master plan clearly delineates the purpose of ICT-mediated learning and the use of web resources with respect to the current teaching and learning practices.

e) *Technical readiness related to infrastructure requirements for ICT-mediated learning:* Interviews with teachers, ICT coordinator, as well as evidence from site observation indicated the followings: (a) the school has met the requirements for implementing ICT-mediated learning, in terms of hardware, connectivity, educational software, software licenses, systems maintenance, and staff training; (b) the ICT infrastructure is already in place as shown by the deployment of broadband Internet access equipped with more than 100 PCs all connected to the network; (c) the school has developed a plan for a new technological infrastructure (Cisco wireless LAN, electronic books); and (d) the existence of the ICT infrastructure and the technological support systems (such as the ICT Working Committee, the network vendor and availability of staff training and development) has been communicated to teachers, parents and students in various avenues such as meetings and school assemblies.

Based on these considerations, it is assumed that the school is ready to use digital libraries as it has the infrastructure and the supporting environment, as well as willingness from students as to act as potential collaborators to develop content. Figure 1 presents the motivating factors that support the plan for realisation of the CDL. Assessments of teachers' readiness indicate that the History subject teachers in this sample are not fully ready to collaboratively build the digital library. The reasons are summarized below:

a) Teachers' ICT competencies is limited and their comfort level to use Internet is low;
b) The extent teachers embrace ICT innovation and change is limited as the teachers have no clear direction on integrating the Internet into their curriculum;
c) Teachers are not aware of the existence of the training support systems.

However, the study indicates that the teachers are taking an interest in the Internet, and they are not exclusively negatives in their judgments of the possibilities of digital libraries. They see the value of digital resources and online publishing for their students. Although they are not aware of and have not used a digital library before, they "seemed" to have an idea what a digital library was. They expressed

willingness to play the role as a facilitator in the digital library project as denoted by the following responses:

- "I want, I have told you before that I wanted to join." (Teacher N)
- "I will give my cooperation, whatever I can afford." (Teacher M)
- "I agree. However it depends on the school's instruction and (History) panel." (Teacher R)
- "I agree and I give my support. I think this project is beneficial to teachers and students. I see there is a need for this project." (Teacher L)
- "I like it and I strongly agree to join." (Teacher S)
- "Yes! I would love to participate and engage in some of the more technical aspects of the project." (Teacher A)

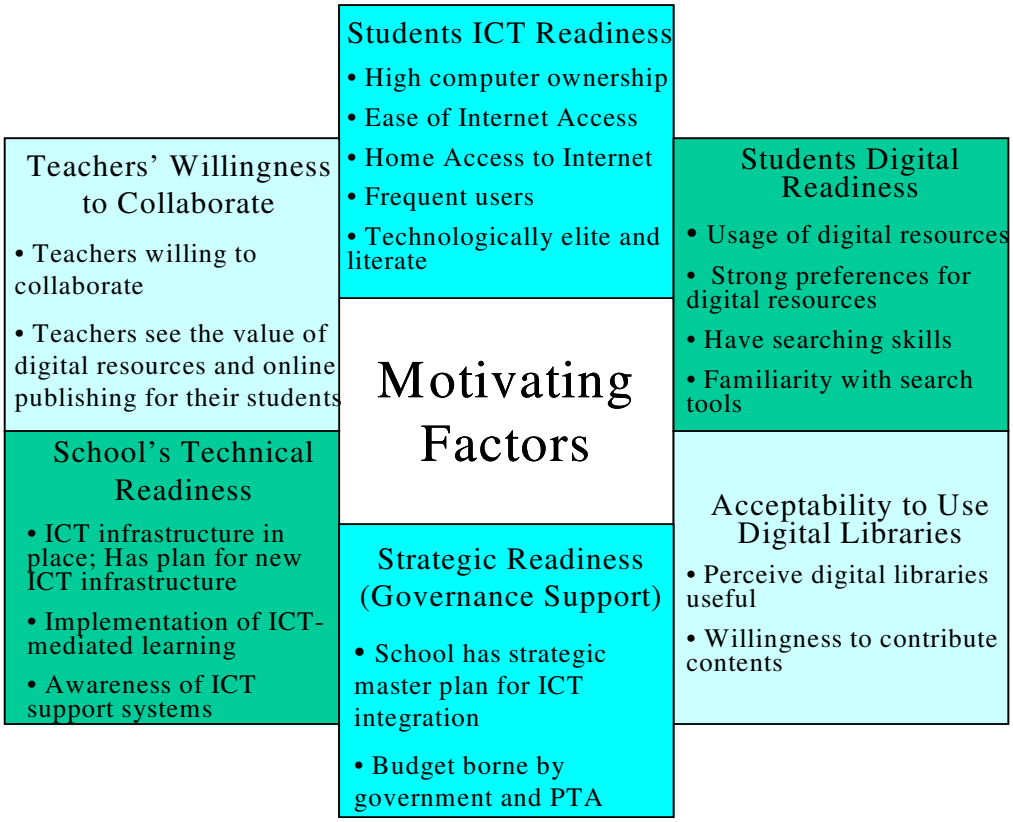

Figure 1: Motivating Factors that Support the Plan for Realisation of the CDL

Planner's Goals and Objectives

In row one, the planner identifies the vision statement needed to define the strategic direction for the CDL project. The CDL has been conceived to support secondary students information needs in conducting research projects. In project-based learning (PBL), students interpret, analyze, synthesize, generate, and evaluate information about a topic, collaborate with others, and report findings (Blumenfeld et al., 1991; Barron, 1998). Through the exploration of a theme and essential question that results in a product, students develop a more in-depth, applied understanding of an academic content area, philosophical issue, or social problem. PBL is especially effective when supported by educational technology (Blumenfeld et al., 1991; Means & Olson, 1997). Research has also shown the approach to be effective in enhancing student motivation and fostering higher order thinking skills, especially when supported by Internet technology (Grant, Michael, M, 2002; Sidman-Taveau, R & Milner-Bolotin, M, 2004). To support students in these types of activities, students need a full compliment of tools designed to meet the unique needs of learners, and Internet technologies such as digital libraries have the affordances to support students in these activities. Based on this premise and fact finding analysis, as well as building from various illustrations of digital library initiatives' vision statement, the planner establishes the following vision of the CDL:

> ***"The collaborative digital library should enable secondary school students conducting history school projects to access the information they need any time and any where, in a friendly, multi-modal, efficient and effective way, by overcoming the barriers of distance and language, and by using multiple Internet-connected devices. The digital library should also enable students to collaboratively build and contribute resources, as the digital library should be seen as a growing knowledge repository on Malaysian local history for education".***

With this vision in mind, the broad thrust and goals for developing and implementing the CDL include:

a) ***Development of Historical Collections:*** The digital library will create, organize and maintain fundamental and quality resources on local history that responds to the research and educational needs of secondary school students.
b) ***Provision of Resources for Lifelong Learners:*** The digital library will be a one-stop centre on the Internet for information on local history promoting lifelong learning. Accommodating lifelong learning means recognizing that there is a shift from teaching to independent learning. The resources in the digital library will serve educational needs of secondary school students, history school

teachers, college students and teachers, and the general public who is interested in local history.

c) ***Provision of Round-the-Clock Access:*** The Internet is a 24/7 medium, i.e., available 24 hours a day, 7 days a week. Access to the digital library content will not be constrained by time limits.

d) ***Information to Be Used for Research and Learning***: The digital library will support specific information behaviors that underpin research and learning such as information seeking, browsing, encountering, foraging, sharing, gathering, filtering, and using.

e) ***Development of Community of Users****:* The collaborative digital library not only provides the path to a rich array of high-quality educational content and services, and also function as a forum where resource users may become resource providers. The digital library empowers students, teachers and other educational community to collaboratively build the digital library resources. It will also develop a community of educators who validate, use, contribute to, and support the collaborative digital library.

In this capacity, it establishes "a digital library service environment" - that is, a networked, online information space in which students can discover, locate, acquire access to and, increasingly, use information. The objective of the digital library is therefore to provide a learning environment and resources network for history education which is: a) designed to meet the information needs of learners, in both individual and collaborative settings; b) constructed to enable dynamic use of a broad array of materials for learning, primarily in digital format; and c) managed actively to promote reliable anytime - anywhere access to quality collections and services, available both within and without the network.

The Owners' Business Plan: An Approach to Use the CDL

Accessing the problems encountered by students in conducting their school projects, as had been highlighted by the students and teachers in the sample, formulate a new model for accessing, producing and sharing resources. The digital library focuses on serving students information needs in conducting research projects. As such, in the implementation of this digital library project, the use of the online resources would be an integral part of history projects-based learning activities. Students should be enabled to access digital resources, create and publish their own documents in the digital library and share them with others. In this case, students should be allowed to create and submit their project report in the electronic format. They are the content developers of the digital library. Though historically, project reports were written

and submitted in paper or scrap-book form, the digital library may move the student community towards an emerging genre of digital resources as teachers too have been allowing students to word-process their report. Thus, as time moves forward, it is more and more common for students to prepare their project report with a computer. Reports that are submitted in the form of scrapbooks could be digitized and published in the "space" allocated for participating schools. With respect to end user access using the digital library, they may search the contents, retrieve collections of search results, and display the contents of result items consisting of multiple media resources**.**

The school shares an interest to ensure that the digital library programme and the programme priorities respond to the students' and teachers' needs and interests, as indicated by the school principal, "I have no objections against this project as long as it instills interests and fulfills students and teachers needs". Teachers would be given the opportunity to utilize their ICT knowledge by validating the quality of submissions to maintain content quality of the digital library, grade projects online, and add links to other useful resources found in the Internet. Pedagogical relevance is a function largely of the creativity and skill of the teachers that use the materials in the digital library. The teachers may also play the role of content managers. They will create indexed collections of multimedia information and make this available via the Web. Access to information means being able to search for information by keywords, bibliographic attributes, and terms matching the text content of information. They will create multiple types of indexes that support searching on fixed attributes (such as keywords, author names and titles) as well as free-text search on text content. The digital library approach to collecting and making available digitized multimedia source material is complementary to computer-based learning systems focused on specific learning topics and approaches, specialized tools for authoring, record keeping and network collaboration. The implementation of the business plan (Figure 2), which is consistent with the current implementation and evaluation of History project (Malaysia, Ministry of Education, 2006), will make the accomplishment of the goals and objectives feasible.

Designer's Mandatory Functional Requirements

Using data from the survey, interviews and review of existing digital library initiatives, the researcher develops the mandatory functional requirement of the digital library expressed as behavioural objectives to populate the Why component of Row 3. Specifically the objectives of the CDL are to:

a) Enable students to search and browse digital resources, by various access points, regarding the topics they are exploring. This allows students to discover and

reuse content that is readily accessible, as information in the digital library is in a single source, obtainable from the point of access. From the students' point of view, the information can be obtained at the same time and from the same place as when it is located. This is in sharp contrast to using traditional resources, which could mean finding one source at the school library, another at the public library, and something else through an interview or personal contact, as timeliness can be a big factor in engaging students in investigations, allowing them to do follow their interests without interruption.

b) Allow students to sequence and organise their project reports in various presentation styles, sequence and organise the references they use in the appropriate format as well as submit the report and other resources in various formats, in order to create materials for publication in the digital library.
c) Enable students to publish' their project reports and set permissions on who can view them, including user-only, their students, or anyone browsing the site. This enables students to share their work with a wider audience and creates different motivations and expectations for students in conducting their History projects.
d) Enable human metadata creation with mediation, that is metadata for a single resource is created by several parties, the author for elements such as title and description, the teacher for subject and keywords, the teacher librarian for metadata useful in various educational information and instructional use/user contexts. The digital library also enables automatic metadata generation for technical metadata.
e) Allow teachers to validate the quality of submissions to maintain content quality of the digital library, grade projects online as well as generate grade lists.
f) Enable students to register as members of the collaborative digital library. A new user (student) is required to fill in their personal particulars, user identification (ID), password and confirm password. The digital library also allows users to edit and update their particulars if necessary.
g) Provide different levels of access to different types of users, based on their user ID and password. Each user group with the correct user ID and password would have access to specific functions of the digital library. The digital library enables verifying the validated user's login identity and password, as well as allowing users to change their password from time to time.
h) Acquire users feedback, submission and description of other useful resources in various formats, as well as links to other useful resources found in the Internet.
i) Provide and display discussions on any issues related to students' projects or resources on local Malaysian history.
j) Able to guide and assist users in using the digital library's functions or services.

k) Allows authorised users such as administrators and teachers to view, add, modify or delete, if necessary the collections and resources in the digital library.

The formulation of the behavioural objectives assists the researchers in the development of the user requirement and successively detailed definitions of the digital library services in order to populate the Function (How) column.

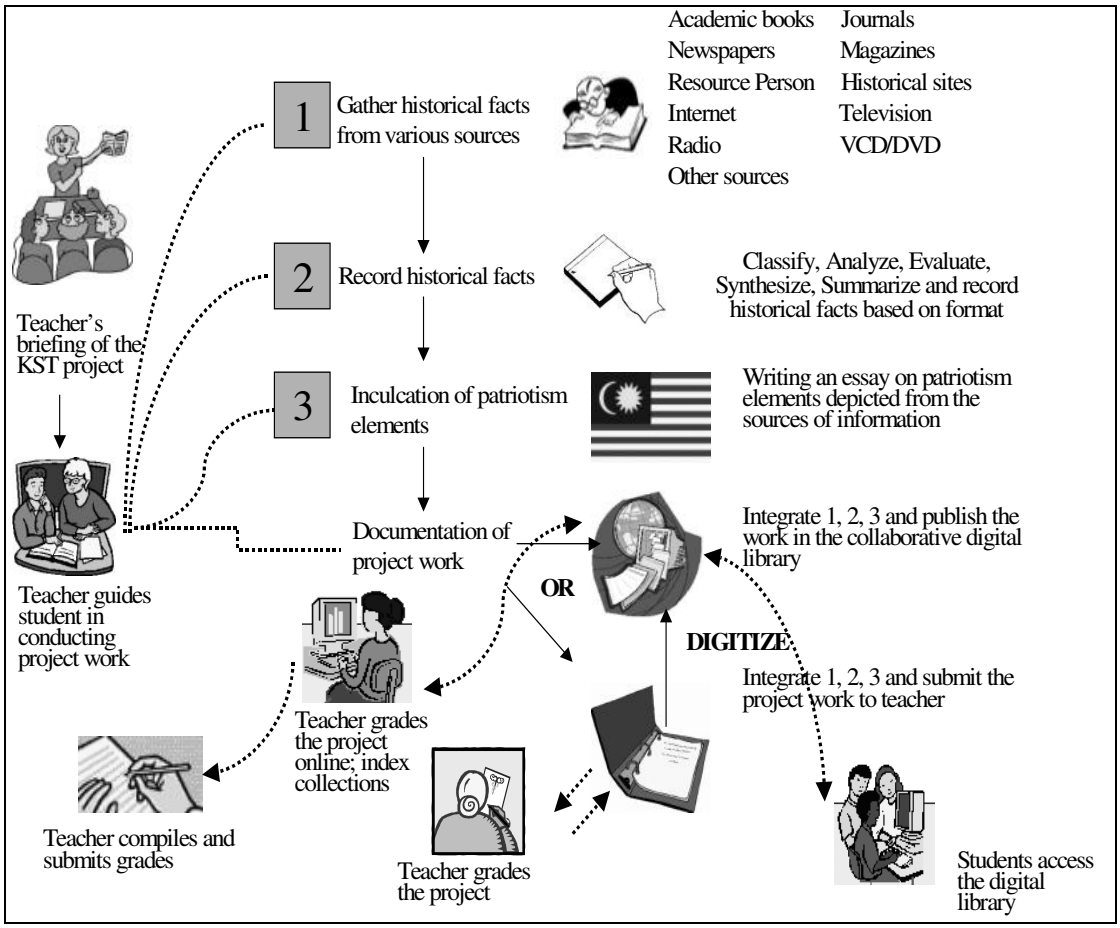

Figure 2: The Business Plan: An Approach to Use the CDL

CONCLUSION

This work has illustrated the possibility of using Zachman Framework for the approach to investigate the user requirements and define the digital library organization, processes, technology and information flows. It highlights a detailed mapping between the first three layers of the motivation cells in formulating the goals and objectives, the business plan or context to use the digital library and the functional requirements of the CDL. The behavioural objectives populating the designer's view of the motivation cell help the researchers to further establish the functional requirements of the CDL.

The outcome of ascertaining the requirements based on the information obtained through multiple fact-finding techniques is the Requirement Matrix for the CDL Model Using Zachman Approach (Table 7). In this work, the columns are arranged so that the most important column or the focus of attention is on the left. The specifications of each cell are identified and descriptively presented. The functioning CDL system (row 6) is ascertained through an analysis of system testing and evaluation by potential stakeholders. It incorporates users assessment of the digital library prototype to evaluate the viability of a useful and enduring collaborative digital library for school projects and shows that the motivation to use, major goals and objectives, business plan to use the digital library and the functional requirements set in the Motivation column of the Zachman Framework used, have been achieved.

As a testbed system, the collaborative digital library known as CoreDev exists more to demonstrate capabilities than to serve communities as has been reflected by the positive feedback on the functional requirements as compared to the feedback on content. The beta tester demographics and user survey results indicate that the CDL is reaching its target communities, and can potentially tell how satisfied those communities are with CoreDev. To date, CoreDev has developed community and governance structures, a strategic plan, a useful collection of 777 resources consisting of 126 documents, 35 projects, 437 images, 23 audios, 34 videos and 90 hyperlinks obtained from both the report generator and the upload function. CoreDev is now available at http://coredev.fsktm.um.edu.my.

Table 1: The Requirement Matrix for the CDL Model Using Zachman Approach

	Motivation (Why)	Data (What)	People (Who)	Process (How)	Network (Where)	Time (When)
SCOPE (Contextual) Planner	1. Motivation to use, major goals and objectives, curricular and programmes significant to the digital library	2. Digital library resources to fulfil students information needs in conducting research projects	3. Identification and description of people and organizations to which the digital library assigns responsibility for work.	4. The activities students perform in conducting research projects; The activities teachers perform in supervising research projects	5. Identification and description of organization and individual location of access where stakeholders use the digital library	6. Events to which the Digital Library responds relative to time
BUSINESS (Conceptual) Owner	7. Business plans to use the digital library	8. Semantic description of domain focus and topics of resources in the digital library	9. Users and related roles (Person & Role Diagram)	10. Conceptual model of services in the digital library	11. The organization's (owner) digital library network diagram	12. Chronology of events and duration of research project
SYSTEM (Logical) Designer	13. Digital library functional requirements	14. Data definition for digital library resources	15. Users and Functional Roles in the Digital Library Architecture	16. Digital library programme modules	17. Digital library notional distributed systems architecture	18. Event phases and process components
TECHNOLOGY (Physical) Builder						
DETAILED PRESENTATION (Out-of-context view)						
FUNCTIONING ENTERPRISE – The prototype	Users feedback on systems overall operation	Users feedback on the ease of handling data	Digital library participant description	User s feedback on procedural and system documentation	Users feedback on the robustness of the network	Users feedback on system operation related to time

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