
# THE IMPACT OF E-SERVICES ON EDUCATION: A CASE STUDY OF THE ELECTRONIC LIBRARY SYSTEM AT DIYALA UNIVERSITY

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# THE IMPACT OF E-SERVICES ON EDUCATION: A CASE STUDY OF THE ELECTRONIC LIBRARY SYSTEM AT DIYALA UNIVERSITY

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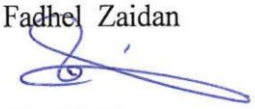
| Signature | : |  |
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## ABSTRACT

**The impact of e-services on education: A case Study of the Electronic Library System at Diyala University**

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Information and communication technology has developed in phases over the years and it has become more advanced in waves of innovation and invention. E-services have passed through several stages of development in a short period. They have also had a positive and negative impact on several sectors in our lives, such as trade, industry, government, education, and medical services. In addition, E-services contribute effectively to raise the level of performance of educational institutions. This thesis focuses on the impact of electronic services in the education sector and the importance of this conversion. In addition, we have discussed the differences between digital libraries and integrated library systems (ILS), by comparing a set of open source software packages offered on each platform and testing each using a virtual environment. Moreover, we implemented the most suitable system that can be applied within the library section of the University of Diyala, and we have discuss the challenges and expected benefits.



**Keywords:** E-service, E-library, The Impact of E-Service, Integrated Library System, Digital Library.

# ÖZ

**E - hizmetlerin eğitim üzerindeki etkisi: Diyala Üniversitesinde Elektronik Kütüphane Sisteminin bir Durum çalışması**

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Bilgi ve iletişim teknolojisi yıllar içinde gelişmiştir ve inovasyon ile yenilik dalgalarıyla daha gelişmiş bir hale gelmiştir. E - hizmetler kısa bir süre içerisinde bir çok gelişim aşaması geçirmişlerdir. Bunlar ayrıca ticaret, endüstri, yönetim, eğitim ve medikal hizmetler gibi hayatımızın bir çok alanında olumlu ve olumsuz etkide bulunmuşlardır. Bununla beraber E- hizmetler eğitim kurumlarının performans düzeyini yükseltmeye etkin bir biçimde katkıda bulunmaktadır. Bu tez, elektronik hizmetlerin eğitim sektöründeki etkisi ve bu dönüşümün önemine odaklanmaktadır. Bununla beraber, bir sanal ortam kullanarak her birini test ederek ve her bir platform üzerinde sunulan bir takım açık kaynak kodlu yazılım paketlerini karşılaştırarak dijital kütüphaneler ve entegre kütüphane sistemleri (ILS) arasındaki farklılıkları tartıştık. Dahası, Diyala Üniversitesinin kütüphane bölümü dâhilinde uygulanabilecek en uygun sistemi uyguladık ve zorluklar ile beklenen faydaları tartıştık.

**Anahtar Kelimeler:** E-hizmet, E-kütüphane, E-Hizmetin Etkisi, Entegre Kütüphane Sistemi, Dijital Kütüphane.

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Finally to my dear mother who has credited after Allah in my success.

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| | |
|---|---|
| AGLS | Australian Government Locator Service |
| AECT | Association for Educational Communications and Technology |
| API | Application Programming Interface |
| CCTV | Closed-Circuit Television |
| ELS | Electronic Library System |
| GIS | Geographical Information System |
| GCC | Gnu C++ Compiler |
| GDBM | Gnu DataBase Manager |
| GPL | General Public License |
| HP | Hewlett Packard |
| LMM | Loans Management Model |
| ICT | Information and Communications Technology |
| IOS | Internet of Services |
| LIBS | Laser-Induced Breakdown Spectroscopy |
| ILS | Integrated Library Systems |
| LMSs | Library Management Systems |
| MIT | Massachusetts Institute of Technology |
| NZGLS | New Zealand Government Locator Service |
| OPAC | Online Public Access Catalog |
| VOIP | Voice Over Internet Protocol |
| PHP | Personal Home Page |
| NGO | Non-Governmental Organization |
| SWALCAP | South West Academic Libraries Co-operative Automation Project |

# CHAPTER 1

# INTRODUCTION

## 1.1. Motivation

The revolutions of information and communication technology (ICT) that have occurred in the 1990s have affected communities in many ways. Side-by-side ICT has had a direct impact also on the local level of development. This effect included both people and institutions [1]. A discussion of these effects includes two important aspects: a discussion of the impact of the use of this modern technology on society and a discussion of the possibility of accessing this new form of service or information [2]. The first perspective discusses the idea that virtual communities may outweigh the proportion of physical communities, which will be reflected as less attention by the communities themselves to the existence of physical things or physical services. The second discussion includes addressing the gap between the communities that have the possibility and the ability to access information services, and between communities that do not have the possibility or the ability to become involved in these types of services. These difficulties include communities of limited education, poor communities, low-income communities or communities that resist change and prefer to receive services in a more natural form.

Services globalization has been introduced because of the massive development in information and communication technology. It also has inspired many sectors to shift to delivering electronic services as electronic services offer many benefits, such as service flexibility, service reliability, easy service deployment, easy service delivery and lower costs in general. Moreover, e-services and advancements in ICT open new horizons and challenges, including how to deliver these services and how they are to be consumed. Electronic services have already affected many sectors, including the business, trade, government, medical, educational and many others sectors. In this thesis, we will focus to the impact of e-services in the education sector.

In addition, we review the importance of electronic services in this area and how such services have helped the renaissance of the education sector as we know it in its current form. One of the services that have helped the renaissance of education is the emergence of the electronic library, which has helped both institutions and students with many issues. E-libraries are a comparatively new model formed from existing library systems and they add the ability of access from anywhere at any time within a pre-defined authority by a wide range of users. This technique, nevertheless, has faced many problems before they were approved. The evaluation of these problems and the activation of the e-library system at the University of Diyala, along with a suggested model for an e-library system as a model case study, will be a priority for this research.

### 1.2. Thesis Objective

Electronic libraries are extended and integrated approaches adopted in traditional libraries. They introduce high-end information systems that improve the services given by institutions. Integrated Library Systems (ILSs) or Library Management Systems (LMSs), Library Automation Software and Automated Library Systems are all known as e-library systems. The standard functions of e-library systems include acquisitions, cataloguing, the Online Public Access Catalog (OPAC), circulation, and digital reference. In this thesis, we aim to emphasize the following objectives:

1. To discuss the manner, applications and issues of e-services that affect the education sector;
2. To discuss open source software that has been used in the education sector, especially software used in the library section;
3. The implementation of this open source e-library system, testing it, comparing it and discussing the results;
4. To suggest an e-library system as a service at the library of the University of Diyala; and
5. A discussion of the conclusion and future work.

### 1.3. Thesis Structure

This thesis consists of five main chapters in addition to a practical side as a case study. These chapters include the following:

**Chapter 1** includes an Introduction and the thesis objective.

**Chapter 2** includes backgrounds and the theoretical part that discusses the impact of information technology and the development and revolution of e-services. Additionally, Chapter 2 provides an overview of the most important components that serve our research criteria.

**Chapter 3** presents a literature review and is divided into four parts according to the evaluation of the methodology over years on development. The methodologies are evaluated according to the established services that have been used in related research.

**Chapter 4** includes the implementation of a set of open source e-library systems, a test plan and a comparison between them followed by a discussion of the results obtained.

**Chapter 5** presents our conclusions and future work.

# CHAPTER 2

# BACKGROUND

## 2.1. Introduction

The revolutions in the service sector have become more important in our business life with the increasing adoption of information and communication technology (ICT). The needs of managing ICT services and maintaining their development is turning into a key concern in many sectors [3]. This service is converted to be an e-service in many ways, and in spite of its being standing technology, it is still not a very well understood subject or position after the analysis of novel improvements [4].

Electronic services have changed the traditional concept of services as a result of the high proportion of Internet use and the revolution caused by the use of smart devices. Nevertheless, the systematic design of these electronic services, and how to orient them as a customer service and the obstacles affecting them, are still under debate nowadays [5].

The impact of services was not limited to one area; it also extended to include many other sectors, such as the business sector, the trade sector, the government sector, the health sector and the education sector. Newer studies from some researchers have suggested a new concept known as *ecosystem services* and *Internet of Services (IoS)* [5]. E-services have become a means for empowering more activity of government, business and education today. It offers the ability to access various types of services and/or self-governing the services process itself.

## 2.2. E-Service

The term *e-service* is a contraction of *electronic service*. An individual, group or even an organization that provides services to stockholders/customers can define it as the use of electronic technology. E-services are classified into two main domains (depending on establishment issues): Information technology for interaction and the actual service delivered via electronic channels. Three concepts have been added to e-services, namely *Automate*, *Information* and *Transformation*.

E-services were first introduced by Hewlett Packard (HP). The idea came from the need of transform traditional business and commerce so as to be manageable and available through the Web. From that time, many types of e-service have been produced, including news services, payment services, weather services, etc. HP describes electronic-services as *"Modular, nimble, electronic services that perform work, achieve tasks, or complete transactions"* [6]. This description reproduces three key constituents: *service delivery*, *service receiver* and *service provider*. On the other hand, *electronic service* is a universal term that can refer to the delivery of any type of service through the Web, including commercial and non-commercial online services [7].

It can also represent one or more selected processes, using the concept of 'e' revolution; it endeavors to offer a service in the form of online services in many different areas. The 'e' revolution has picked up on this fact. For example in business, it was used to create E-Business; in local government, it was used to create the E-Government; and in learning, it was used to create E-Learning.

Additionally, these services needed a suitable model to be managed and developed, and for that purpose, the European Union has projected an e-Service Model that includes six stages to develop any type of service, as follows:

**Stage 0**: The service provider does not have the ability or intention to provide the service he owns through any type of network;

**Stage 1**: Providing information on the service that is required and making it available in the form of an electronic service;

**Stage 2**: Making these services available in a one-way interaction such that the user can download a full on-line form;

**Stage 3**: Shifting these services from one-way interaction machinery to two-way interaction such that the user is able to provide feedback;

**Stage 4**: This phase is dedicated to making electronic services have the ability to allow more interaction with users, such as decision-making. The ability for an openly reachable website is accomplished by the service provider. At this stage, it is preferable a move to full electronic life; and

**Stage 5**: E-services should provide more personalization services, such as automatic service delivery, pro-active service delivery, provision for specific services and ensuring a high quality of service.

### 2.3. E-Service Paradigm

There are many e-service paradigms that can be used to design and deliver many types of service, such as the front-end approach, the back-end approach and the intermediate approach. Brief descriptions for each approach are listed below [8]:

1. The front-end method emphasizes the design of web-based applications that can provide services to many types of users with any smart device or PC, such as via government portals.

2. The back-end method is where the services provider focuses on integrating or improving some services so as to facilitate stockholders, customers or other service providers, such as applications used by government geographic information system (GIS).

3. The intermediate approach is when a service provider explores end users' needs so as to design a dedicated service. As a result of using this method, it

may claim to produce applications belonging to the front-end method or back-end method.

### 2.4. E-service Value

The abstract framework of the value behind the use of e-services is demonstrated in Figure 1. It appears as the core ideas behind high usage of e-services and the reason for high adoption of e-services in many sectors.

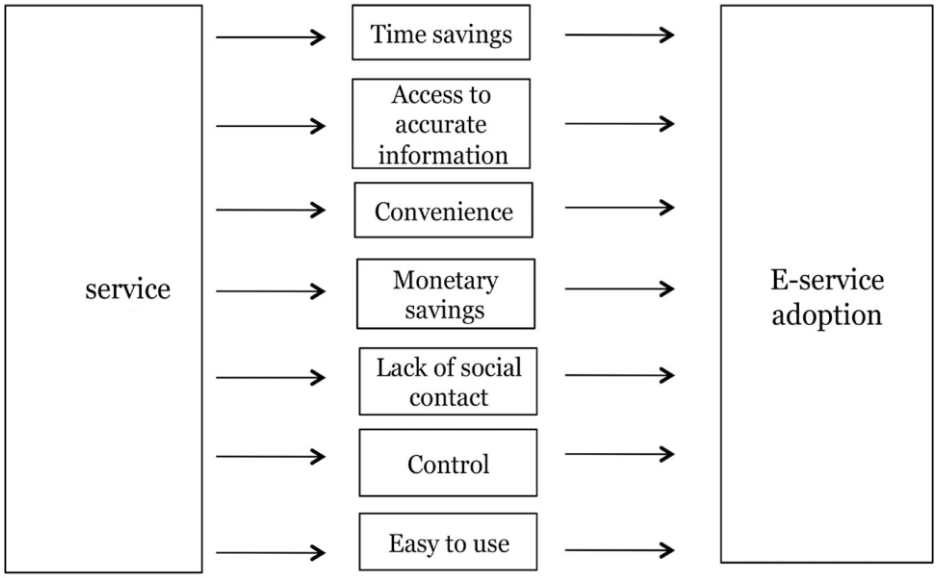


**Figure 1** Conceptual framework [9]

The value of e-services is a vital component of the status behind the high use of e-services in the current time. E-services can be classified as functional value and non-functional value. The functional value can be any benefit related to a task itself, while non-functional value relates to any benefit that arises as a result of the use of this service. Good examples of functional and non-functional value are time and cost [10]. All e-services values will be presented on an individual basis, wherein we will characterize and discuss them briefly within a usage environment in the following sections.

### 2.4.1. Time saving

The time factor is one of the most important factors that lead users to a greater use of electronic services. E-services, in fact, were designed to save consumers time [11].

The detection of saving time that is offered by many applications of e-services is very important for all consumers. The use of the Internet is potentially a way to save time, and e-services were designed to attract users in this conceptual fact [12].

For example, the time spent in a shopping center is a good reason for many consumers to shop online [13], and the most important reason was that it saved time. This reason includes the following: less time required for online shopping, less time to search for a product, and reviewing different products at the same time. Many consumers opt for online shopping as they can control their own time [14]. Time saving can also be an influential factor in many other sectors.

Moreover, in the circumstance of using traditional services, many end users find that the use of e-services applications are more captivating due to the prospect of time savings, i.e. the usage of e-services permits the process of service to be performed far more efficiently than the time expected in proceeding with traditional services [15].

Many researchers state that, the speed of service delivery is one of the most important factors that affect the use of electronic services, which may be the most important for this type of service attraction, not only for end users but also for the service provider [16]. Saving time while using e-services is likewise a comparative asset that is comparable to consumers' vision about the delivery of a service [17]. A number of consumers who do not have much time (or they consider they consider their time valuable) may see electronic services as a perfect way to save time for themselves and re-use the gained time to accomplish other things they consider more important [18]. Finally, many end users consider e-services as more favorable because they offer the value of use

of any type of service at more flexible times [19]. Service convenience can be defined as saving end users time and effort when they use e-service applications [17].

### 2.4.2. Information Access

Both the content of the information and the access to information are pertinent aspects for any type of e-service [19]. The Internet and the use of the Web have become significant tools to search for information. E-services are a part of services delivery around the world. It can be used as a tool for searching information in a timely manner, as well as for searching a huge amount of data from single phrase, in addition to speedily retrieving related information [20].

A number of studies state that the ability of customization and searching for information are what motivate people to use e-services [21]. On the other hand, the type of information is also vital. Some researchers classify online information in two categories: valuable information and sufficient content [22]. Valuable information can be considered in terms of significance, appropriateness and distinctiveness. Some information, such as personal information, can be considered valuable for the mobile market. This type of information can be part of the valuable information category, while sufficient contents have to characterize comprehensiveness and inclusiveness [23].

Users who use e-services prefer to obtain information about a product before trying it. Such information may include professional tips, reviewer tips, users' advice, rankings, company information, author backgrounds, etc. All this information can be considered to be a benefit of using e-services [24].

### 2.4.3. Convenience

Satisfaction and convenience are part of the value of e-services. Consumers can receive satisfaction or convenience with the use of any type of e-service, which enables consumers to consider e-services as valuable tools [25]. User-friendliness as an element of these online services is significant to provide consumer satisfaction [26]. Other elements include manageability, such that the end user can

manage the service and productivity, such that there are low search costs and the ability of access at any time. All of these factors are used to provide consumer satisfaction regarding specific e-services [27].

A number of studies have shown that user satisfaction can be obtained when users feel that a service is available at any time and in any place [28]. On the other hand, other studies have shown that users feel more comfortable using electronic services due to the fact that they feel more freedom [29]. Yet other studies have found a link between the sense of satisfaction and the time factor as discussed earlier in this chapter. This study divides the time factor into *time orientations*, *time availability*, and *time allocations* [16].

### 2.4.4. Economic savings

There is no doubt that the financial and economic sector has the greatest impact on the service sector. Here, the concept of the electronic service reduces this impact and provides the same service more efficiently in a relatively good economic system [30].

Previous studies state that cost is a vital factor for online users [31]. Other studies show that the cost savings in e-services is considered to be a valuable factor for consumers to continue to use e-services [32]. In addition, prices can be controlled through electronic services by applying the concept of pay-per-transaction. Other studies have shown that users tend to use systems that they believe will help them to save money [30]. Saving money may include the costs needed by the user to go shopping, receiving a service, browsing costs and product costs. Such costs will be reduced when using electronic services. By using e-services, the consumer has the opportunity to acquire a service at the lowest possible price [26].

Saving money also includes the service provider in several aspects, such as the cost of stock, operating cost, product cost, service fees and maintenance costs [12]. A number of recent studies have shown that the consumer identifies the use of electronic services for both savings and cost [30]. From the above mentioned, it becomes clear that saving money is the greatest demand of most users looking to

receive a service at the lowest possible price, which is precisely what is offered by electronic services.

### 2.4.5. Social Contact

Social networking is one of the most important problems of the sticking points to discuss now. These problems include an individual's isolation and other social problems. From another point of view, this is a practical benefit that may claim to increase the turnout of many users to use electronic services more so. Some users prefer electronic services to avoid feeling hesitancy or to feel more privacy through these services where they live a virtual reality [33], other users feel more comfortable with electronic services where they can answer their questions with often greater freedom [26].

A number of other users may complain of view services or methods of sales and purchases by processors in classic ways. Therefore, they prefer to use the virtual world to use these services [30]. Some studies have shown that users feel more transparent with electronic services [26]; therefore, a general lack of social contact can be seen as a positive point that contributes to increased user demand to use electronic services even though this point is considered a problem in some other aspects of life.

### 2.4.6. Control

The consumer enters occasionally as a key factor in the assessment of human resources that provide a service; therefore, many studies have suggested the introduction of the consumer as part of the success of the services provided. This role has become greater and more interactive with the emergence of electronic services such that the user is able to receive the service without receiving help from an employee. The concept of control is defined as the feeling that gives the user control of the service itself [34], while interactive control means the ability to perform the services process without the need of a service provider interaction [26]. Many studies have shown the desire of the user to control the service or a preference for self-service, which gives a user a feeling that he dominates the

process of the service operations. This is also provided through the concept of electronic services [35].

Electronic services can give the user control over the operations in several ways, such as the mechanism of the transaction process, the appreciation of self-service, observing control, and controlling service quality [26]. Electronic services provide an opportunity for the user to manage business activities and these are considered a magnet for consumers to use e-services; this includes the meaning of "You can start using the service when you are ready," the control of the process of the service with the consumer being a responsible part of service quality. These activities make the user more integrated with the conduct of electronic services operations. From the above, we can understand that giving the user a feeling of greater control over the services process would be a positive point to attract users towards the use of electronic services that are already provided by e-services.

### 2.4.7. Easy to Use

Ease of use has always been one of the main factors that attract users towards the implementation of services which depend on the concept of electronic services. It is based on the conversion of the normal form of service into electronic format. This will contribute effectively to facilitate the process in addition to interacting with these types of services [36].

Most often, in order to interact and perform certain types of electronic services, the user is encouraged to be sufficiently familiar with self-efficacy and an ability to deal with the electronic world. These factors allow users to understand and perform electronic services successfully [37]. Many previous studies clearly state the importance of ease of use in order to attract more users to the electronic world [17], while other studies state the ease of use allows consumers to feel more confident when using e-services [21]. Moreover, a revolution in the world of smart devices, such as smart phones and tablets, is the other reason for the provision of a flood of electronic services that are both easy to use and easy to access. Customer satisfaction can also be another factor that increases the use of e-services. Customer satisfaction can be achieved via ease of use. From the above,

we can be certain that ease of use is one of the many benefits offered by e-services.

## 2.5. Education Technology

The concept of education technology is a relatively new concept that both mixes and incorporates teaching and learning [38]. Educational technology can be defined as *"the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources"* according to AECT (2008) [57]. It is important to understand the definition of education technology in order to distinguish between the use of this term by technicians and the use of this term as a tool to serve the goals of education. Other researchers define the term of educational technology as the area concerned with solving problems, a methodology by using tools, theories, methods, and techniques from numerous fields of awareness in order to serve many goals in general, such as to evaluate, develop and design resource materials and lead the process of transition from the old system to the new one [38]. In general, education technology can be summarized in Figure 2.

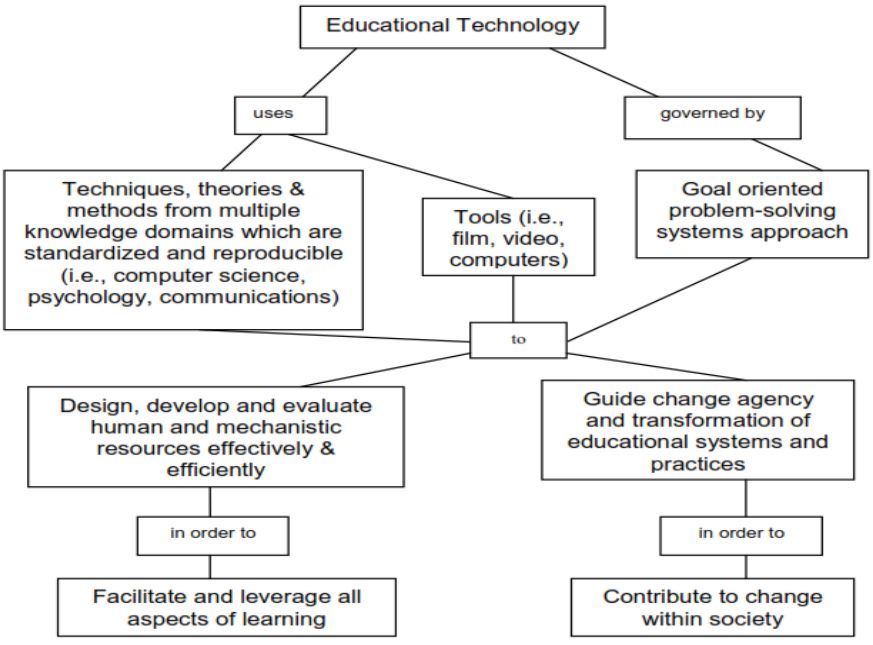


**Figure 2** Educational technology in society [38]

When reflecting on the figure above, we find that it is clear that technology is being used as a tool in the development of education. This includes the overall tools that have evolved through history, including CD players, DVD players, PCs, smart devices, pocket computers, tablets, mobile devices, data shows and digital video cameras. In addition to the smart classes, it includes both hardware and software [39].

On the other hand, the evolution of the World Wide Web having spread around the world has effectively contributed to the development of education technologies in several forms, including blogs, forms, and communication lines. Social networking platforms have also been used to expand this effect, where every person has low-cost ways to communicate with each other across the world. Many of these means have been used mainly for the development of new education processes. This has also contributed to the development of the concept of distance learning as well as the emergence of new forms of education, such as e-learning, mobile learning and open learning [40].

Moreover, new types of training have also developed, such as teleconference based training, web based training, and flexibility based training [41]. In the present time, the term *virtual education* is used in many education centers as a way to deliver education to students around the world without the need for physical attendance. Virtual learning offers many advantages such as the non-necessity for a physical presence for both teacher and student. The time factor is not important but there is the possibility of controlling the quantity and quality of education [41].

In addition, the concept of e-learning has changed and has been adapted in many ways. These changes include utilization, development, evaluation and management of the procedures and resources of education. In the present time, most of the means of education have changed to include new concepts in the use of information technologies to serve the goals of education. E-learning today has become a successful alternative to the regular education in many educational establishments around the world [42].

## 2.6. The Impact of ICT on Education

Electronic services as a part of information and communication technology have affected many sectors of life, such as the business sector, the government sector, the public health sector and the education sector [37]. The impact of e-services on the education system has been the focus by many researchers since the start of the information and communication technology revolution. It still holds this interest at the present time with side-by-side effects in other sectors.

Many researchers have successfully shown the existence of a growing relationship between the developments of information technology and the development of education. This relationship includes many factors, such as the ease of access to information, the amount of information displayed, transparency and many other factors [13].

Some researchers have carried out a comparison study between groups of people who take certain education and use certain tools without the use of any type of modern technology and with other groups receiving the same amount of information. They use the same content materials, but through modern technology. The results clearly outweigh those of the people that received the same content using the technology [43].

The use of information and communications technology has expanded the horizons by offering better education through the use of several tools, such as electronic games, educational programs, and websites specializing in education, multimedia applications, and the e-learning model. There are also many studies that show how various positive impacts can be received through the use of information technologies in the education sector, such as saving time and many other positive outcomes for both students and education organizations [41].

On the other hand, other studies show that the use of technology in education systems is not always beneficial, where the use of technology needs a server and many other items to be successful, such as the organization of the vast amount of information required for many of the accessories, which are important for the

success of such a change. This may include providing a professor with knowledge about how to use the new technology. Current education regulators also need sufficient knowledge from the student in order to interact positively with these tools [39]. At present, the need to assess the impact of the use of technology in the education system is urgently needed more than ever. Moreover, it needs greater effort from researchers to study and more interactions with regard to different learners [44]. Figure 3 shows the relationship between ICT and education.

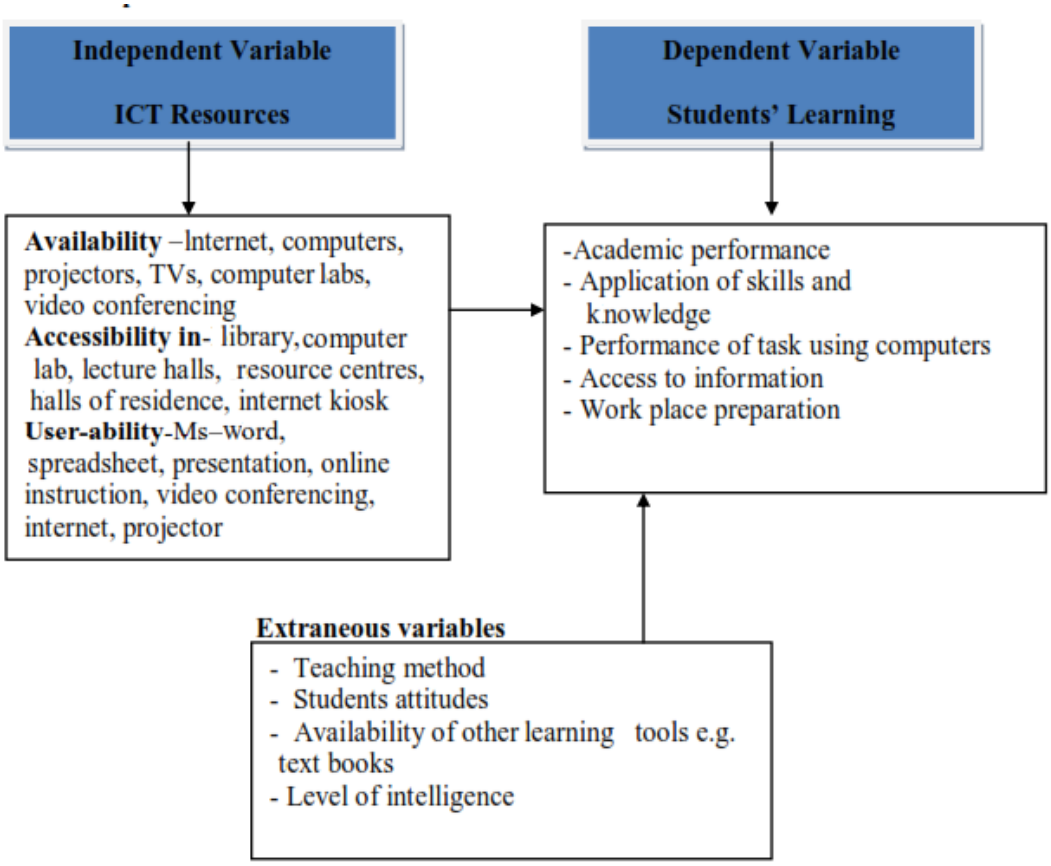


**Figure 3** The relationship between ICT and education [44]

## 2.7. ICT Barriers in Education

There are many obstacles that may be encountered when applying the concept of some applications related to information and communication technologies within the education sector. These obstacles include access to these services, knowledge of how to use these services, and the availability of these services. The following section will provide a simple explanation for the most important of these obstacles [45].

### 2.7.1. ICT Availability

ICT hardware and software have always been the appropriate tools to activate the role of modern technology for educational purposes. The availability of such resources can be a major factor that affects the application of this technology. On the other hand, modern technology contributes effectively to improving the level of education and the level of learning. This has been proved recently through many studies made by the Swedish National Association for School Improvement.

### 2.7.2. ICT Accessibility

The absence of a strong infrastructure for information technology in most educational institutions is one of the factors leading to the decreasing use of education technologies. In the correct form, these infrastructures lack networks within educational institutions. Moreover, they lack suitable Internet links and interactive web sites for educational institutions. They also lack an e-learning model, computer-based labs and smart devices in the school net [42]. Some recent studies conducted by the British Education Communication and Technology Agency have stated that the ability to access technology is one of the most important factors that allow the integration between technology and learning [18].

### 2.7.3. ICT Knowledge

Knowledge is also considered to be one of the challenges facing the education technology sector on three levels: *students*, *teachers*, and the *education institute*. The lack of awareness and knowledge of using modern technological tools impacts negatively on the use of information technologies. Modern technology has provided many opportunities to increase educational opportunities around the world, but simultaneously it has contributed to the increase of the responsibility of the student, teacher and educational institute to use this technology positively [35].

### 2.7.4. ICT Cost

The economic factor is one of the most important determinants that may positively or negatively affect activating the role of technologies being used within the education sector. The cost of ICT equipment, including hardware and software, the maintenance of such equipment, the cost of training in the use of such equipment, operating costs, and the ability to ensure the continuity of the provision of such services may all be obstacles in the face of activating the positive role of information technologies [45]. So the ICT cost have direct effect to overall education process.

# CHAPTER 3

# ELECTRONIC LIBRARY SYSTEMS

## 3.1. Introduction

In this chapter, we will review electronic library systems as an example of the impact of use of information technologies in the education system. We will also review the historical development of library systems at different stages. In addition, we will discuss electronic library systems and digital libraries, and the relationship between Open Source and Library Systems, in order to make a comparison between the most popular library systems that operate in this area in the next chapter and come out with the best system, which can be applied as a case study at a library of the University of Diyala.

## 3.2. Electronic Library System

An Electronic Library System (ELS) is defined as an academic or public library management system. This type of system application was developed specifically to manage the overall operations of library management functions within libraries. It was developed later to include the possibility of accessing it from external links. Each task is usually performed by the Electronic Library System associated with a specific model, which is responsible for doing a specific task [46]. This model includes many elements, such as the loans management model (LMM) and the OPAC model to provide the ability of external access and an acquisitions model which is used to regulate the registration processes within the library. In addition, the circulation model is used to regulate the circulation of books between users and the library, and the indexing or reference model is used to organize books within the specific number system for easy access to those books within the library process. An Electronic Library System is a very practical system for library management. It has many benefits for many library workers such that it is easy to use and easy to manage all library functions quickly and efficiently.

### 3.3. Literature Review

For a better understanding of the causes and factors that led to the emergence of the Electronic Library System, we need to gain an impression of the literature review that led to its appearance over the years. If we take the fact that libraries have existed since ancient times, the last fifty years would be considered to have contributed significantly to the development of an Electronic Library System as a result of accompanying the tremendous development that took place in information and communication technologies. Below is a brief decade-by-decade explanation of each stage of development in the last fifty years.

#### 3.3.1. Tentative Systems

During the 1960s, it was the first attempts to exploit the computers that has been invented to process the information management. The first attempts were carried out by the local library management system at the American and British Libraries [47], where it was thought that these systems would help in the management of information despite the simplicity of the technology at that time. The common systems of the time appeared as an eighty-column, stamped card invented by IBM in 1928 [48]. Figure 4 shows an IBM 80 card.

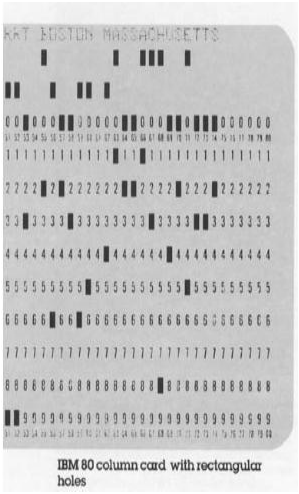


**Figure 4** IBM 80 card [48]

This card design was used in the 1960s for a system of administration in libraries. In the present time, one may find some evidence of this use in the following

quote, *"When I first started working in libraries, we had a punched card system at Exeter City Library, Castle Street. I left in 1969, but I remember the clunky sorting machine which needed a room of its own (a small room!). It was an innovative system at the time."* [48].

At this stage, Library Information Systems were used for the first time at the University of Missouri by Dr. Ralph Halsted Parker [49]. This system is the digital reflection of traditional library operations, and it was the first attempt to find books with information technologies.

Moreover, in Britain, specifically at Southampton University, there was a study on the possibility of the use of information technology as a system of administration in the university library. This was conducted by Rollo Woods [50], and it was considered to be the first attempt to use information technology in the education sector. This study concluded the following: *"A new wave of enthusiasm is sweeping the world of libraries in Britain. Librarians see that it is possible to use computers for most clerical operations in libraries. As a result of the recent Flowers report, more computing machinery will be installed in British universities, and librarians are anxious to stake claims for shares in increased computer time, which will therefore become available.... The purpose of Program is to assist librarians in learning about what is the beginning to be done in this field, to provide a medium for discussion of the problems involved, and to help establish direct personal contact between those working in similar directions."* [50].

At this stage, most libraries are considering improving their performance through the new opportunities arising from this change of use in the new technology. This was not limited to university libraries; it also extended to public libraries, as evidenced convincingly by the re-organization of the London boroughs. At this historic juncture, there were many problems and challenges facing this change as a result of the simplicity of the evolution of the technology, the lack of available resources and the high cost of personal computers. These challenges include:

- The lack of personal computers: The only computers available being very large and expensive centralized computers;
- Software in the primary meaning (machine code language) where code is required to be written for each process; and
- Workers in libraries and programmers having no idea of the profound importance of using this software.

### 3.3.2. Limited Local Systems

During the 1970s, a new library system concept appeared called Library Automation Systems. With many facilities for information technology and personal computers during this phase, library automation systems became the evolution of these systems, which attracted the attention of researchers at this stage, where the old regulations of most university libraries and public libraries used card systems, as we reviewed previously, the new trend now is for libraries to use local systems with a more sophisticated ability which was due to the following several reasons:

- The development of technology at this stage;
- The expansion of the field of scientific and academic research in various disciplines;
- An improvement of the means of communication between programmers in the libraries sector; and
- Enhancements to management and system design.

With these, a new system for library management appeared at this stage. There were also several ways used to develop the administration of these systems. However, every system had the same concept of recording information about books and administration system book loans. There are a number of examples of some universities which have already developed local systems of library administration at this stage. These include following:

At the beginning of the 1970s, Sussex University implemented a document management system used primarily in the management of libraries. This system was considered to be an effective alternative to the older card system.

Moreover, later during the 1970s and specifically in Camden Public Libraries and other public libraries in Luton, the system was implemented, where they applied a complex system for the analysis and management processes of the libraries. These applications were also supported by Oxford University.

At this stage during the 1970s, computer systems were implemented in one of three different ways:

1. Time sharing and online processing: Actions depend mainly on the central post computer to execute operations on a group of terminal computers for library operations where employees can communicate with the central computers directly;

2. Batch processing: Operations are carried out in sequence by the principle of ending one process and carrying out other operations. Simultaneous multitasking processes is not yet available; and

3. Remote job entry: This is the implementation of a set of processes that are a mix of the concept of time sharing, online processing and batch processing. This method also allows the use of networks for the transmission of data.

The 1970s was the era of successful local systems in libraries. In general, many systems were developed for this purpose, which were useful to perform basic tasks for any library. These tasks include reference control, sharing resources, circulation and cataloging. The most famous program at this stage was the application produced by the British Library called MERLIN [51]; this software was able to carry out on-line book ordering and information acquisitions.

Despite the successes achieved during the 1970s, the development process faced a number of difficulties, including:

1. Software

   At this stage, there were also many problems related to programming languages and the lack of adaptation to the requirements or its inability to meet the requirements.

2. Hardware

   Hardware failure and the large size of components, the cost of a personal computer and maintenance were also many common obstacles faced during this stage.

3. Users

   Here, there are two sides: the first obstacles were of knowing where the user has to use this system, not knowing how to use it, or having very little knowledge about how to use these systems. The second concern arose from the systems themselves, where they could not meet all user requirements.

### 3.3.3. Turnkey Systems

During the 1980s, we saw the basic steps of the world of information technology in terms of the development of solid equipment, personal computers and the reduction of costs as relatively acceptable to many users. These developments were contributions made by giant company such as IBM, Apple and HP (Hewlett Packard), was all of which contributed effectively in developing the concept of personal computers. Moreover, the process speed for operations increased, which had a deep impact on software development in general.

This era has seen much competition between companies to develop both hardware and software. As a result of this competition, each company endeavored to provide the best solutions, the majority of which they offered were compact forms of hardware and software, and referred to as Turnkey solutions [52]. These solutions include several advantages:

- The user need not worry about problems related to hardware and software integrity;
- The ability to manage a personal computer within the library;
- Equipping the provider with more credibility and reliability of its products with respect to strongly dependable solutions; and
- A more stable system and fewer problems for users.

A number of companies and institutions have provided successful solutions in this period that are dedicated to a library's needs. There are many success stories in this regard, among which are the following systems [52]:

1- BLCMP (Birmingham Libraries Co-operative Mechanisation Project) System

This is a standalone turnkey solution, also known as CIRCO, which was used in polytechnic libraries in the City of London's Barbican.

2- GEAC (Genetic Engineering Appraisal Committee) System

The Geac Computer Corporation of Canada developed this system. It is used in the Guelph and Waterloo libraries as university libraries. Moreover, many university libraries in UK have used the same system.

3- ALS (Arrowhead Library System**)** System

Derbyshire County Library, as a county library, has used this system.

4- CLSI(Clinical and Laboratory Standards Institute ) System

This system was developed by the US Company, CL Systems Inc. The system is also known as LIBS 100. Its success as a system of library management is proved by its broad uses in many libraries in the USA and Canada.

5- Plessey System

Also known as the Module 4 system, this system was used in Canada at the Calgary Public Library. As a turnkey solution, it has successfully achieved its goals of implementation.

In the presence of a fair number of new systems, new possibilities have been made available to users, such as the ability to search in databases for specific information about books, including book name, year of publication, author name, and other information. A new technology emerged during this time named "Online Public Access Catalog" (or OPAC). This new technology allows access to databases from external beneficiaries. Moreover, this technique has gone through several stages through which it has evolved. It has recently become commonly used in many libraries because of the astounding possibilities it offers [52].

A key factor that has contributed to the development of library systems at this stage was the existence and the beginning of the use of microcomputers. These new devices offered many capabilities to these library systems, including [53]:

1. Data integrity crosswise over many applications;
2. The provision of more data interactive transmission; and
3. Providing ease of use and mobility between the processes within the system.

During this phase, many research and educational centers organized many seminars and conferences which aimed to establish awareness for the user and managers around the world to show the importance of the uses of a library system in both private and public libraries [52]. These activities include the following:

1. The establishment of scientific journals specializing in this area;
2. The establishment of specialized centers to answer questions related to these systems around the world;
3. The provision of programs and demonstration material about library systems around the world; and
4. The establishment of conferences and seminars dedicated to this purpose.

At the end of this era, systems were able to carry out several tasks, such as circulation, acquisitions, controlling, book loans management, OPAC and cataloguing materials [51] in the library.

### 3.3.4. Customizable System Development

The final stage in the development of electronic library management systems lasted from the 1990s to the present day. It is clear that there was greatly accelerated development in information and communication technology, which significantly impacted the meaning of library manage. This vital revolution was especially made in services that were discussed previously in Chapter 2.

During the 1980s, individual library systems were used with no possibility of multi-tasking; therefore, the most important characteristic of the new era is the possibility of simultaneous multiple tasks for multiple users. The development that took place in the telecommunications sector has allowed many library management systems to be more interactive with the end user in addition to being more interactive with each other than ever [54]. Figure 5 shows most of the functions of the ILS system during this stage.

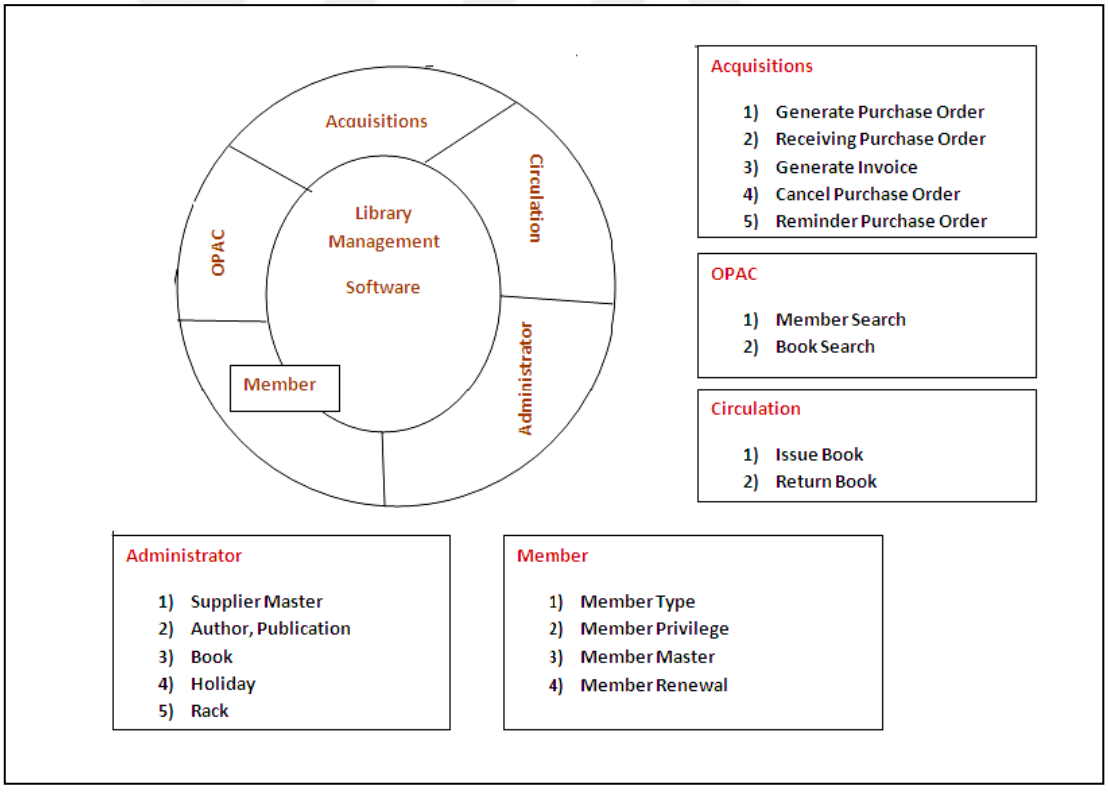


**Figure 5** Most of the functions of the ILS system at this stage [54]

Moreover, widespread use of the Internet in the present time has added many easy-related services to many libraries, users and workers, including: easy access, easy searches for information with greater accuracy and higher reliability, and the use of new material appearing in this period, such as web-services, cloud computing and distributed systems.

British universities were some of the first universities to have taken advantage of this development for the benefit of library systems, as exemplified by the first application of the library management system named SWALCAP(stands for South West Academic Libraries Co-operative Automation Project) [53]. Within the modern concept at Reading University Library, and as a new experience, it has also suffered from many problems, the most important of which was the inability of the system to accommodate the growing number of users. The Mather Company was not able to overcome these problems, which led to the migration of users or most users no longer using this system around the world. In addition, it moved to use a new library management system, ultimately leading to the company no longer offering this service.

Moreover, in this era, many developments effectively contributed to the successful use of the library management system. In the next section, we review the most important of these developments [55].

1. **Information Technological Advances**

   As previously discussed, the library management system was used in development within their own operating system. However, the development in information technology broke these barriers. As a result of the evolution of many programming languages and diversity in the capabilities offered by these programming languages, it has now become possible to develop an independent library management system to run on multiple operating systems and one that supports cloud computing and web applications in addition to performing multiple tasks, simultaneous operations for multiple users at high rates of efficiency in a timely manner.

2. **Electronic Services**

   As previously discussed, the massive development that took place in the services sector contributed significantly to the development of many applications in various other sectors. The library management system was also affected by these changes and developments, which resulted in offering a new range of new services, including Web Services.

3. **E-mail and Communications Sector**

   There is no doubt that the development of modern communication systems has contributed significantly to the expansion of the capabilities of a library management system. Through the use of new ways to communicate with end users and managers, the developments include the use of modern VOIP technology, CCTV systems and e-mail services.

4. **Improved Accessibility**

   The evolution in local and public networks has increased the possibilities of access to public libraries through the OPAC. Moreover, the new protocol used is the Z39.50 protocol [53].

### 3.4. Open Source and Library Systems

The Open Source Systems are open systems that allow access to their own source code within the licenses framework. They allow changes in their code for many purposes, including the re-distribution of the software to anybody or to study the code and re use it for any purpose [56]. It is considered to be an opportunity to develop new systems or modify existing ones. The idea of open source software is also used by developers to create a wide range of library management systems while allowing multiple potentials, such as managing several workflows, cataloging and managing diverse processes in contemporary physical libraries. This allows for re-use and development free of charge, with the existence of high competition from the commercial sector.

Quality, and service delivery, is becoming the most important differences between the two groups [57]. The commercial version of library management systems is

supported by a dedicated team belonging to the system manufacturer. Open Source library management systems generally offer two types of support. The first is free of charge and made by the community. The second is low cost and made by a specialized development team belonging to a system manufacturer.

The web and programmer community are pushing the library management system in new ways. In fact, they aim to provide better regulations at the lowest possible price, and in most cases, allow complete access to source code free of charge [56]. This will help to open new approved systems that are completely free.

Open source alternatively can be used to operate in different operating systems and can be relied upon in all libraries to face economic and financial difficulty, especially if we know that a commercial version of a library management system is relatively inexpensive. Although open source systems are low cost, some libraries may need to incur some expenses such as training on the new system or programmers or specialists to reallocate systems to fit the exact work of the beneficiary Library. Therefore, we find that most libraries choose to operate open source systems based on two factors: the desire to reduce system costs and the desire to reduce the cost of maintenance. Additionally, there is the desire to acquire a system that meets a library's interactive requirements with the freedom to modify code and have more development in the future [57].

There is also a fundamental difference between the two systems used in library services, which some researchers find confusing. These two systems are the library management system and the digital library. The Library Management System functions were discussed in the above section. The digital library system is dedicated to the management of electronic documents and is used as a retrieval system [58]. In the following chapter, we discuss this difference more deeply and work with comparisons between different systems used in both systems.

# CHAPTER 4

# DISCUSSION AND COMPARISON

## 4.1. Introduction

There are many open source systems built on this basis in various parts of the world. There is also the difficulty in determining the actual number of these systems and counting them due to the presence of millions of websites. In this research and through the adoption of the regulations, we will select the most common open source library systems, which own global assets, comparing the prospects features offered by each product after testing them in a virtual environment. In addition, we will select the most suitable system that can be applied at the library of the University of Diyala followed by a discussion of the challenges and expected benefits of the system.

## 4.2. Digital Libraries

Library management systems are used in normal library operations, such as the control of orders made, tracking customers who have borrowed books, item tracking and many functions such as cataloging, referencing, public access to library systems and circulation. A digital library system is used mainly to manage electronic documents and as a retrieval system, in agreement with the Federation of the Digital Library [27]. A Digital Library can be defined thus: *"Digital libraries are organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities."* Digital libraries occasionally mix between the specifications of a library management system and the features of electronic document management so as to be a comprehensive solution in a single system. To study this diversity, we need to have exposure to the most popular digital library systems in accordance to the global assessment [59 and 60] and compare them with each other, as provided in the following section.

### 4.2.1. Greenstone

Greenstone is one of the most important open source systems used in the management of digital libraries. It is based on the GNU/GPL license pack [61]. It was developed first by the University of Waikato. This suite of software is mainly based on managing groups of digital data that are organized in collections. Each collection may contain thousands, or millions, of documents. The idea of organizing data in collections greatly facilitates the management of these data; and more control offers an easy search. Moreover, it supports various extensions of digital data such as video, audio, PDF, images, plain text, HTML, LaTex, ZIP and many other file types. The Greenstone suite of software is the result of joint work between the University of Waikato, UNESCO and the Human Info NGO. It also supports many languages, including almost 60 languages in the reader interface and over 20 languages in the software interface, including the five most common global languages (Chinese, English, Spanish Arabic, and French). Moreover, the system provides many metadata formats, such as Dublin Core, NZGLS (New Zealand Government Locator Service), AGLS (Australian Government Locator Service) and RFC 1807. It also supports custom metadata formats with plugins such as XML, CSV, MARC, and OAI, and others. The system also supports multiple properties in order to carry out advanced index searches. It can work in a network environment or as standalone software, in addition to its ability to publish its collections on the Web or on removable media such as CD/DVD and USB. Figure 6 [61] shows the user base information.

| | |
|---|---|
| Distributed via SourceForge since: | 11/2000 |
| Average downloads per month since then: | 5000 |
| Currently running at: | 3800 |
| Total number of downloads (as at 1 June 2015): | 949156 |
| Software downloads proportion Windows / Linux / Mac / Source: | 76% / 13% / 8% / 3% |
| Number of countries downloaded from: | 170 |
| Number of people on Greenstone email lists: | 770 |

**Figure 6** The Greenstone user base [61]

### 4.2.2. DSpace

DSpace is considered to be one of the common tools used in digital library management. It is open source software, written in Java and JSP and developed by a team of participants at the Massachusetts Institute of Technology (MIT) and Hewlett-Packard (HP) in 2002. Since it is hosted on the Source Forge web site, it is used by thousands of organizations around the world. Many universities and institutes have been involved in its development around the world as it has received a broad spectrum of support from programmers and developer communities.

Through this software, it is possible to create open digital repositories. Moreover, it is completely customizable so as to fit the requirements of any organization. Through the use of easy web interfaces, it allows for the hosting of a broad data set. Additionally, it supports many metadata schemes and many other features. Figure 7 [62] shows a simple DSpace diagram.

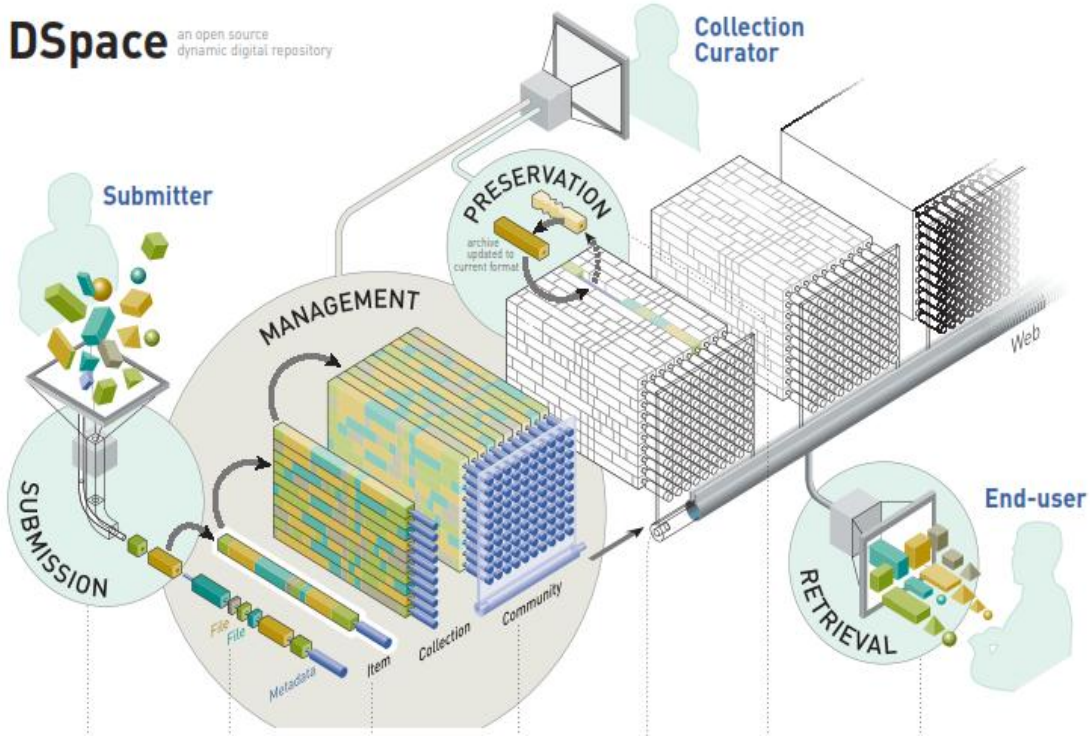


**Figure 7** Simple DSpace diagram [62].

### 4.2.3. Fedora

Fedora, or Flexible Extensible Digital Object Repository Architecture, is an open source repository system that is used to manage digital libraries. It was first developed through a joint working group at the University of Virginia and Cornell University. Since 2001, it has been used in many different organizations, including government agencies, IT-related institutions, museums, cultural organizations, professional societies and many university libraries and archives.

In addition, it received an amount of support by code contributors, service providers and sponsoring organizations. The Fedora project has received financial support from the Foundation of Melon [63]. Fedora is a web-based application and has a wide range of flexibility to support different types of data content and support for different types of standard metadata, such as RDF and XML. It also can host objects of any size and provide a flexible index content search in addition to many other features. Figure 8 shows the Fedora component stack.

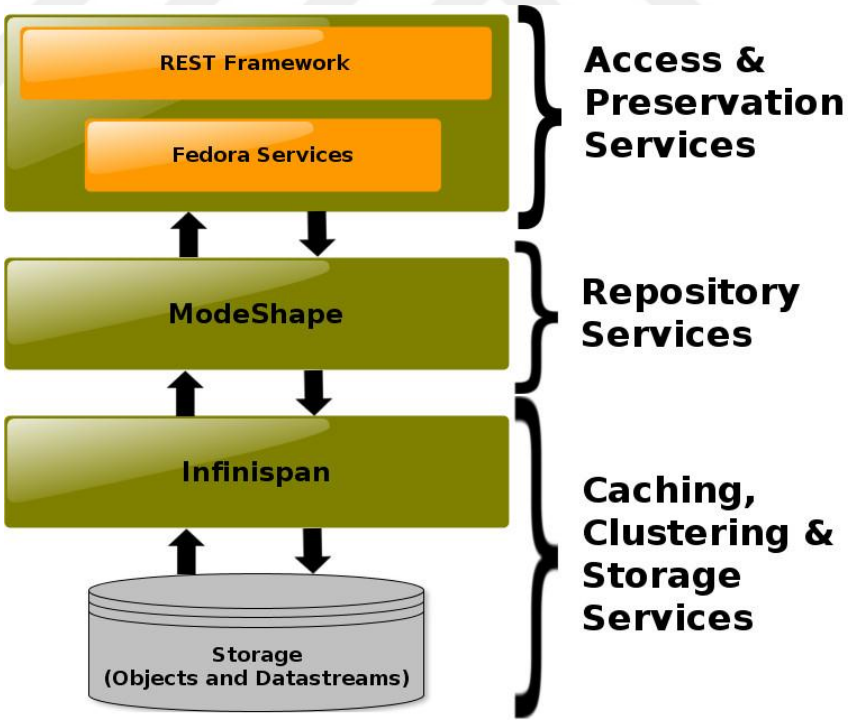


**Figure 8** Fedora component stack [63]

### 4.2.4. EPrints

EPrints it is an open source digital library system. It is a non-profit commercial services organization, a web-based application, and it is considered to be a complex system due to its many features. First developed in the UK by the University of Southampton in 2000, and published under the GNU license pack, it is dedicated mainly to scientific purposes and supports many standard types of data content as well as many data sets. It has its own metadata format and it allows import and export features with the use of XML, METS.RSS and Dublin Core. In addition, it provides effective management for users; however, the control of users' rights and powers is not integrated. It also provides specialized interfaces for administrators such that they can implement most of the configuration settings related to the customization of the system. In general, it is not easy to use, and lacks user-friendly interfaces [64]. Figure 9 shows the Eprints architecture diagram.

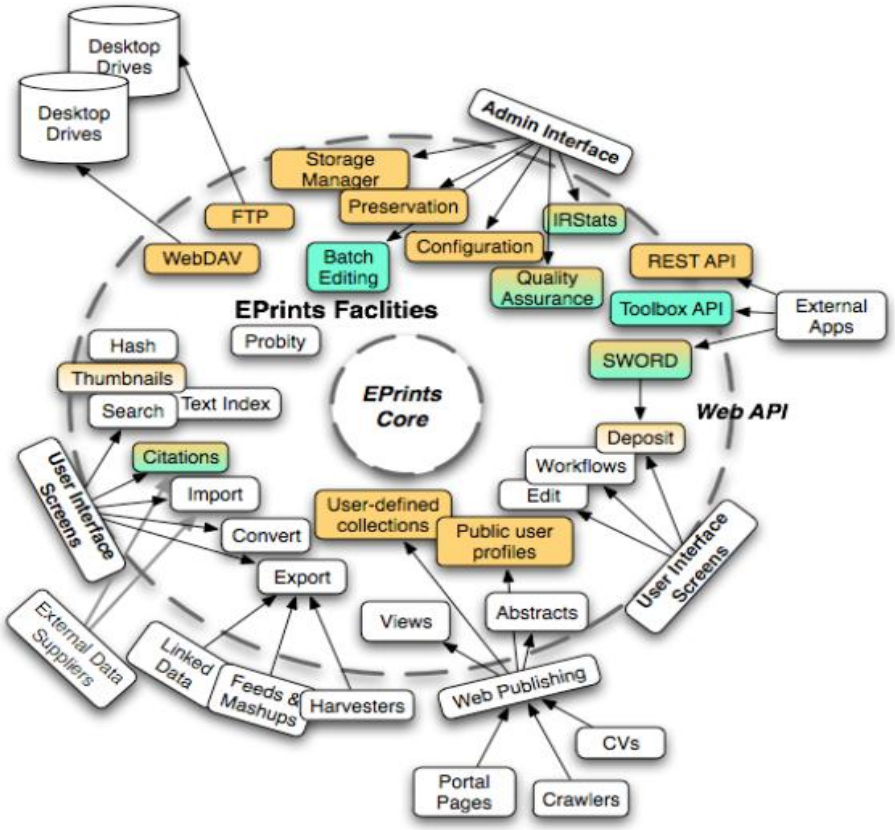


**Figure 9** EPrints architecture diagram [64]

### 4.2.5. Digital Libraries Comparison

As we reviewed in the previous section, the most important software concerns the establishment of a digital library system. We will make comparisons of the most important technical features for each platform. Table 1 shows specifications obtained after downloading each mentioned software and installing each on our platform and testing it.

**Table 1** Digital Libraries Comparison

| | Greenstone | DSpace | Fedora | Eprints |
|---|---|---|---|---|
| Development organization | University of Waikato, New Zealand | DSpace Foundation, Massachusetts, USA (MIT/HP) | Cornell University, University of Virginia, USA | University of Southampton, UK |
| Publishing | 1997 | 2002 | 1997 | 2000 |
| Written language | Java | Java | Java | Perl |
| System support | Yes | Yes | Yes | Yes |
| Database supported | GDBM database | PostgreSQL, Oracle | MySQL, Oracle | MySQL |
| Operating system | Windows, Unix/Linux, and Mac OS-X | Windows, Unix/Linux | Windows, Unix/Linux | Windows, Unix/Linux |
| Z39.50 protocol | Yes | No | No | No |
| OAI-PMH | Yes | Yes | Yes | Yes |
| Identifiers | Their own | CNRI | Their own | Their own |
| Content acquisition | Yes | Yes | Limited | Yes |
| Metadata | Dublin Core, RFC 1807, NZGLS, AGLS | Dublin Core | RDF, XML | Has its own Metadata |
| Authentication | Yes | Yes | Limited | Yes |
| Flexibility | Yes | Limited | Yes | Limited |
| User Friendly | Yes | Yes | No | No |
| Content Manage | Yes | Yes | Yes | Self-arch. |
| Multilingual | Yes | Yes | Limited | Limited |
| User Admin. | Yes | Yes | Yes | Limited |
| Retrieval system | Yes | Yes | Limited | Yes |

### 4.3. Integrated Library System

In this section, we will review the most important open-source software used in the service of the objectives of the establishment of a library under the classification of an Integrated Library System.

#### 4.3.1. OpenBiblio

OpenBiblio is an automated library management system that was developed in PHP. It is an easy-to-use web-based application with high efficiency in performance covering the most common library management models, such as cataloging, circulation, OPAC and staff management. It can support different types of documents, including the UNIMARC formats. In addition, it is open source software published under the GPL Licenses pack; it supports cataloging in the MARC-21 format [65]. As a system known in library management systems, it is one of the most promising developments in the future.

#### 4.3.2. PhpMyBibli

PhpMyBibli, also known as PMB, was developed in France by Francois Lemarchand in 2002. It provides three basic features, namely documentary products, content management and publication. It is mainly used as a library management system. It is a Web 2.0 technology based application and provides an integrated portal to manage a library. Moreover, it is multilingual and supports geo-referencing(associate something with locations in physical space). The system has been tested with 2 million records and shows good stability [66]. It is to be an interoperability system due the use of the Z39.50 protocol, the UNIMARC cataloguing format, the ISO-2709 format and the XML format. Moreover, it supports two models: the portal module (OPAC) and the management module. The management module has many roles, such as cataloguing, circulation, selective dissemination of the information and the watch module, authorities, acquisitions, and CMS. Furthermore, it is completely free due its open source software that was first published under the GNU General Public License, and re-published under the CECILL free license.

### 4.3.3. KOHA

Koha is considered to be one of the best open source Integrated Library Systems. It is published under the General Public License and was first developed in New Zealand in 1999 by Katipo Communications. However, it was not published until 2000. It is powered by very broad community support from many developers. It is written in the PERL language and requires Apache Web Server and MySQL database. Moreover, it works in both Linux and Windows environments, and provides all standard library functions such as cataloguing, acquisition, control, circulation, MARC, Z39.50 protocol, RSS feeds and OPAC [67].

### 4.3.4. EverGreen

EverGreen is an open source Integrated Library System which is published under the General Public License. It was first developed at the PINES16 Program [68] at Georgia Public Library Service in 2005. Since then, it has been used on a large scale within the same program in over 270 public libraries. This software is now maintained by a dedicated developer team working for the Equinox Software Company. This company offers the software as a service with the following: support, migration, development, consultation and training. Furthermore, it provides many models inside it, such as reporting circulation, OPAC, cataloguing. However, other models, such as acquisitions and serials, are in progress. It also offers support for MARC and the Z39.50 Protocol. EverGreen is mainly written using Perl, but some extended features allow it to make a number of modifications in the C language. Moreover, the user and library staff interfaces are written in Mozilla XUL, and OPAC was developed using JavaScript and XHTML [68]. EverGreen works in both Linux and Microsoft Windows, and supports the PostgreSQL database.

### 4.3.5. Integrated Library System Comparison

In this section, we will make comparisons of the most important technical features of each platform. Table 2 shows the specifications obtained after downloading the mentioned software, which were installed and tested on our platform.

**Table 2** Demonstration the specification of Integrated Library System

| | OpenBiblio | PMB | KOHA | EverGreen |
|---|---|---|---|---|
| Operating systems | Windows and Linux | Windows and Linux | Windows and Linux | Windows and Linux |
| Developed | Dave Stevens | eFrancois Lemarchand | Katipo Communications | Equinox Software |
| Program language | PHP | PHP | Perl | Perl, C and Python |
| Database | MySQL | MySQL | MySQL | PostgreSQL |
| Reporting | Yes | Yes | Yes | Yes |
| Published | 2006 | 2002 | 1999 | 2005 |
| Metadata | UNIMARC | UNIMARC | MARC | MARC |
| Flexibility | Limited | Limited | Yes | Yes |
| User friendly | Yes | No | Yes | Yes |
| Acquisitions | No | Yes | Yes | Yes |
| Serial | No | Yes | Yes | Yes |
| Multilingual | Limited | Yes | Yes | Limited |
| User admin. | Yes | Yes | Yes | Limited |
| Circulation | Yes | Yes | Yes | Yes |
| Retrieval system | Yes | Yes | Yes | Yes |
| OPAC | Yes | Yes | Yes | Yes |
| Cataloguing | Yes | Yes | Yes | Yes |
| ILL and Z39.50 protocols | No | Yes | Yes | Yes |
| Stability | No | Limited | Yes | Yes |
| Community support | Limited | Limited | Yes | Limited |
| Ability to expand (integrity) | Limited | Limited | Yes | Yes |
| Documentation | Limited | Yes | Yes | Yes |

## 4.4. Implementation

After we reviewed the most important tools used in the construction of library systems and demonstrating the most important differences in each group in Tables 1 and 2, the results occurred after testing these systems in our personal lab. We also visited the library department at the University of Diyala in order to understand the actual requirements of the Library departments and the most important obstacles currently facing their work. After collection and analysis of the data, we selected the appropriate open source systems as a proposed system to use at the University of Diyala. From the researcher perspective, the best open source digital library is Greenstone, and the best ILS is Koha, depending on our analysis comparison tables. The researcher suggested using Digital Library as the content management system for the University of Diyala. This can help them to store and manage books found in both hardcopy and softcopy formats, while the researcher suggested ILS simultaneously being used by library staff to manage the library's daily functionality. The next section will provide further information about how we can take advantage of these suggestions.

### 4.4.1. Why both Digital Library and ILS at the University of Diyala?

The title may be puzzling at first glance. This is because the two platforms may appear similar in terms and the concept of building an e-library at the end. However, they actually have many differences in the number and types of functionality performed by each platform. These include usability, purpose and types of output for each. After reviewing the functionality of both Digital Library and the ILS systems, the researcher suggested to use both systems to serve the overall goals of the e-library system at the University of Diyala for the following reasons.

The Digital Library system has a content management system. Collections of books can be exported to CD/DVD or to a soft copy format, while users can use the ILS system to search for book details and library materials; however, they cannot keep anything or use it as a soft copy in an offline situation. This feature in the Digital Library system can have a competitive advantage over the ILS system.

Moreover, library staff can use the ILS system to carry out cataloguing, acquisitions, serials management, reporting, authorities, label printing, and many other tasks. In fact, they can perform every type of management, library style functionality with lack of content management while the Digital Library System focuses on the Content Management System more so than the library management itself. This means when one uses both systems in a library, end users and library staff can take both advantages offered by either platform.

### 4.4.2. Why Greenstone for the Digital Library at the University of Diyala?

As a digital library system, there are many reasons that have led us to select this system:

1- It is a full content management system;
2- It fully supports more than 60 languages in reading mode and more than 20 languages in system interfaces, including the five most common languages: English, Chinese, Spanish, Arabic and French;
3- It is supported by UNESCO and the Human Info NGO;
4- It is a highly interoperable system due to its support of many contemporary standards;
5- It supports several types of metadata formats, such as *Dublin Core*, NZGLS, RFC 1807 and AGLS;
6- It is robust, easy to use and cheap to maintain;
7- It has full text and fielded search features;
8- It supports many types of plugins that expand its software features;
9- It supports most multimedia file extensions, so collections can contain video, audio, text and images;
10- Collections can be exported to CD/DVD and USB media;
11- Greenstone is supported in Linux, Windows and MacOS;
12- It supports high compression techniques in order to reduce the size of text and indexes;
13- It automatically produces access structures; and
14- It supports both API and Web-based applications for user browsing. Figure 10 shows Greenstone as a digital library main interface.


**Figure 10** Greenstone as a digital library main interface

### 4.4.3 Why Koha for an Integrated Library System at the University of Diyala?

We have selected this system for several reasons, including:

1- Software cost: Koha is open source software published under the GPL license;
2- Maintenance costs: Koha is widely supported by the developer community and offers low-cost maintenance options;
3- Comfortable local modifications: Koha has a wide range of customization tools provided inside it;
4- It is easy for users, administrators and staff to use;
5- It is free of charge. Upgrades are available for any new version released;
6- Multilingual support and translatable services are available;

7- It is able to do full text searching;
8- It is Library Standards Accommodating, such as UNIMARC, ARC 21, SRU/SW, z39.50, SIP/NCIP and SIP2;
9- It has complete Web-based Interfaces for both OPAC and Admin;
10- There are no restrictions as the software is free to use and can be re-edited and published;
11- It has a full performance integrated library system feature, including comprehensive library functionality from basic to advanced processes. Modules include circulation, acquisitions, serials management, reporting, cataloguing, authorities, label printing, and many other features;
12- Koha is classified as an enterprise integrated library system; and
13- Koha can work as a stand-alone system or through many branch offices over a network. Figure 11 shows Koha system components.


**Figure 11** Koha system components

### 4.4.4. Laboratory Preparation

In order to implement the library system, we need a laboratory that works efficiently. Furthermore, we need to meet the requirement for each system before installing it. In order to achieve this, we used Oracle VirtualBox as a virtual laboratory and both Windows and Ubuntu Linux to meet system requirements. For Greenstone, we need to install the following in the Ubuntu Linux environment: GCC (the Gnu C++ Compiler) and GDBM (the Gnu DataBase Manager). For the Koha system, we need the following requirements to be installed in the Ubuntu Linux environment: Apache Server, MySQL data base and a Perl program compiler. Our lab comprised two machines: our personal laptop was used to host both the main Oracle VirtualBox and host the Greenstone Digital Library System. The second machine was a Linux Ubuntu server that was used to host the Koha integrated library system. Figures 12 and 13 show our lab diagrams (1 and 2).

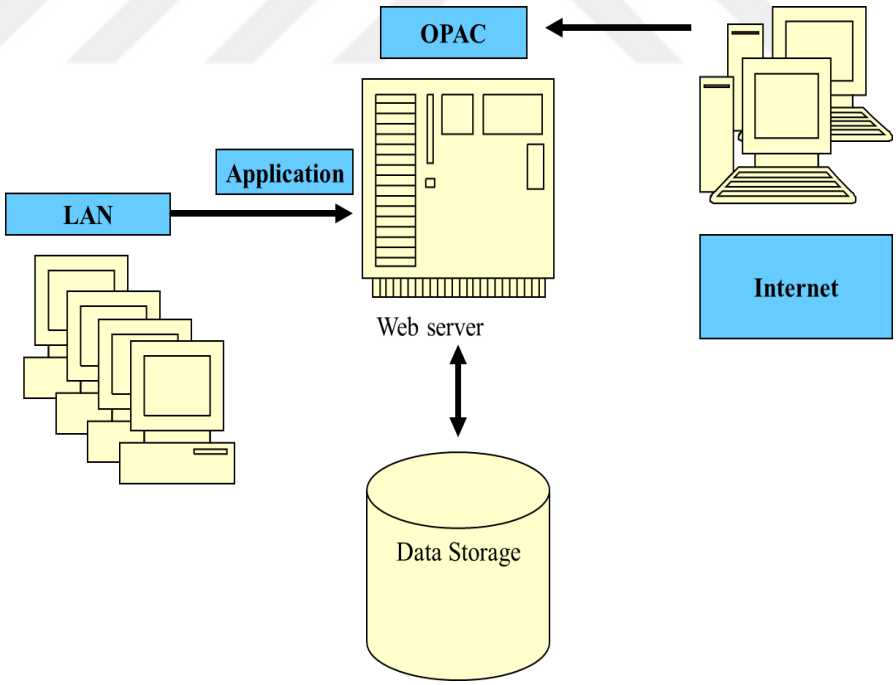


**Figure 12** Lab diagram 1

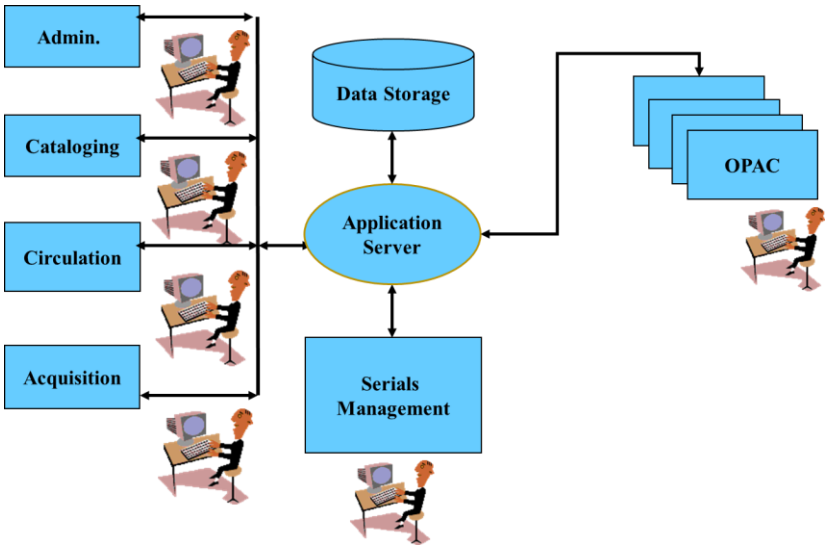


**Figure 13** Lab diagram 2

Implementation of the system was carried out according to the above in a virtual environment.

Figure 14 shows public access library pages in Greenstone as a digital library where the user can browse a collection of books in softcopy format. Figure 15 shows the main online public access catalog (OPAC) login pages in the Koha system where the user can search book details.

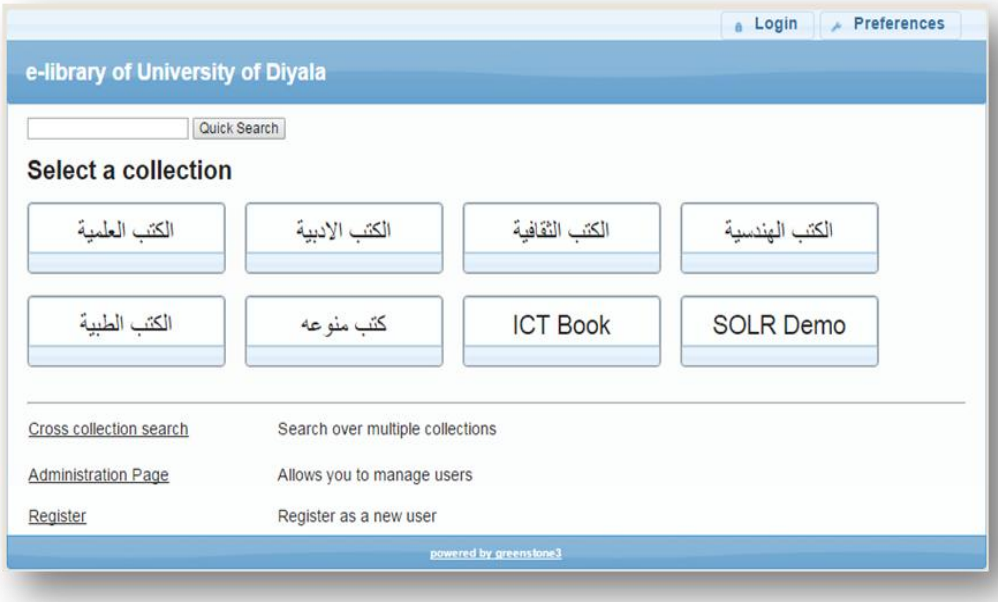


**Figure 15** Public access library pages in Greenstone

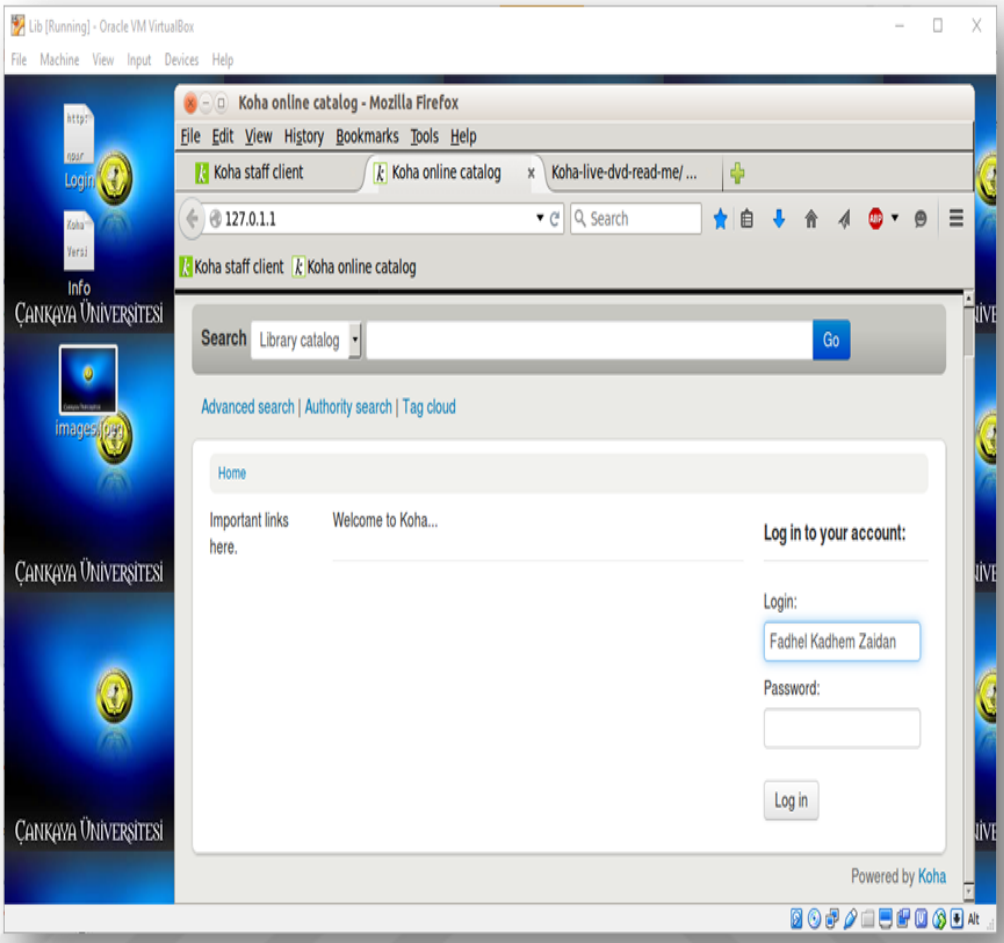


**Figure 15** Koha OPAC login pages

After a successful login to the system by the end user according to the authority given to him by the system administrator, the user will be able to review books in softcopy format. Figure 16 shows a book browser within a digital library.


**Figure 16** Book browser within a digital library

## 4.5. Expected benefits of using both Digital Library and ILS at the University of Diyala

As discussed in previous chapters, with the impact of electronic services on the education sector and a review of the development process of electronic library systems, these library systems provide many services to end users, administrators and library staff. Certainly, we receive many benefits. The expected benefits resulting from using the proposed system at the library of the University of Diyala are listed below:

1. Free access to many resources with the ability of remote access through OPAC;
2. Advanced search tools and retrieval systems;
3. A richer library system and ecosystem;
4. Openness of learning 24/7 from anywhere with offline access;
5. Cost effectiveness;
6. Time savings;
7. User friendly interface;
8. More comprehensive and structured approach for library staff;
9. Integration with other digital libraries around the world;
10. Support for multimedia, such as video, audio and image content along with text books; and
11. No physical boundaries.

# CHAPTER 5

# CONCLUSION AND FUTURE WORK

## 5.1. Conclusion

Through this research, we reviewed the importance of information and communication technology for education and the impact of electronic services on the education sector. Furthermore, we reviewed the impact of this development on the Libraries Systems as an example of the impact of ICT on the educational process, followed by a review of the different systems that have been used to develop electronic libraries as attempt to increase the efficiency of the library services provided. We found that there are two types of electronic library systems that may cause some confusion among researchers, those systems being the digital library system and the integrated library system (ILS), also known as the Library Management System. We then selected a group of open source software packages that depend on global assessment and we put them into two groups depending on establishment purposes, downloaded them, installed them in our lab with preparation of all configuration requirements needs by each system independently; then, we tested these systems in order to create a comparison study to obtain the best systems possible in each group. We then discussed why this selection was made and customized them as a proposal system for the Library of the University of Diyala. Through the experience of all these stages and the literature review, we concluded the following:

- The proposed systems must be fully integrated to take full advantage of all services provided by them;
- Library workers need extensive training so that the services can be provided to improve the work of libraries;
- System interfaces must be easy to use for users and library workers alike;
- A revolution is needed in the conversion of the manual system currently in force in libraries to a completely new system that offers new services;
- Human and technical resources are needed in order to provide these services through these systems;

- Greenstone and Koha are systems suitable to work in any library of any size;
- Greenstone and Koha systems are flexible and dynamic systems which allow free modification and future development; and
- Greenstone can be used as a digital library system with powerful features, such as in the capacity of a content management system, while the Koha system is considered a comprehensive ILS system.

## 5.2. Future Work

After reaching the objectives of the research and a long time after that, we spent time in the preparation of the specific requirements for each program in order to complete the process comparing the process. The process was certainly not without problems and challenges. We can make a number of recommendations for future actions, including:

- All system interfaces having to be supported by Web interfaces;
- Major adjustments having to be made to OPAC services in order to provide more interactive services;
- End user feedback facilities needing to be available;
- Integration development between digital library systems and ILS systems;
- A proposal for practical recommendations to digitize analog materials and metadata;
- More development in user management to include all services provided;
- Improving security and privacy issues.
- Improving the new e-library structure; and
- The improvement of indexing and identifiers.

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|---|---|---|---|
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| English | Good | Good | Good |
| Turkish | weak | Work on the development | Work on the development |