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Feasibility study of establishing an integrated geographic information system: a case study of medical libraries

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Abstract

Purpose – Medical libraries can extend their resources' accessibility by creating a network through web-based geographical information system (WEBGIS) that connects physical and non-physical resources. Geographical information system (GIS allows) libraries to create strong connections with other libraries by establishing a shared server for loading and using digital information. This research aims to explore the feasibility of creating a unified GIS-based service system for medical libraries.

Design/methodology/approach – The target population for this study includes a total of 32 medical libraries across three medical universities (in this case called A, B and C). A researcher-designed 34-item questionnaire was applied in this study.

Findings – Findings revealed that the libraries affiliated with University A have the highest average (46.54%) and better situation in terms of all of the needed infrastructures. Furthermore, in terms of the technical infrastructure required for implementing the integrated WEBGIS, the libraries of University B are in a better situation in comparison with other libraries (64.55%). Weak technical infrastructure belongs to libraries affiliated with University C, with 59.17% availability of infrastructure. The findings underscored the existing gaps in various aspects and highlighted the need for further improvements, particularly in financial and legal aspects, to enhance the overall availability of infrastructure.

Originality/value – This study was conducted for the first time in medical science libraries. The findings of this research shed light on the shortages within the surveyed universities in terms of human infrastructure. Results highlight the need for financial, legal and technical support to bridge the gap between the current status and the desired situation. By focusing on improving the various infrastructural aspects, libraries can foster a conducive environment for the effective utilization of spatial information systems, ultimately benefiting academic research, education and overall information management in the field of medical sciences.

Keywords Academic libraries, Integrated library management system, GIS–libraries, Spatial representation of information resources

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Introduction

Efficient and timely access to information resources in university libraries is an important factor in determining the value of information and increasing the number of library users. Lack of user access to information resources at the appropriate time diminishes the value of these resources and reduces users' confidence in utilizing the library (Afshar, 2000). With the expansion of communication networks, especially the Internet, and the growth of information resources providing up-to-date and rapid information, implementing changes in the provision of services and improving rapid and better access to information resources using innovative technologies in traditional libraries as centers of knowledge is inevitable (Cervone, 2008; Chen and Tsou, 2007; Mash, 2008; Nazimoglu and Yasemine, 2010; Ramzan and Singh, 2009; SPREMIĆ *et al.*, 2008). The increasing growth of publications, shortage of space, lack of specialized staff, budgetary constraints and the distance that users must travel to access information resources or the number of times they must visit the library are all barriers to accessing a comprehensive collection (A.J, GOZO, 1985). In this regard, libraries expand their communication and activities beyond their premises to reach users throughout the country, region and world to provide better services (Brown and Duguid, 2000) .

One of the problems that users often face when using large library collections is the inability or difficulty in locating library resources. Some of the reasons for this problem include the method of managing library collections, the variety of classifications in each library section, the illogical organization of shelves, the lack of guide labels on shelves and users' unfamiliarity with methods of searching for information resources. As a result of this unfamiliarity, users become disoriented among the sections and struggle to solve their problem by identifying different sections, asking reference librarians or other students, but due to the lack of guidance, they remain unsolved (Currie, 2002; Jenkins, 2001; Xia, 2005).

One possible solution to the problem of users struggling to locate library resources is to present the information visually, using images, visual resource tracking or maps to help users quickly understand the exact location of each resource. To achieve this, creating a map is a necessary prerequisite, which requires the implementation of a dynamic processing mechanism. Maps should be responsive to users' searches, so geographic information system (GIS) technology appears to be an ideal solution (Xia, 2005). GIS is a powerful tool for collecting, storing, retrieving, transferring and displaying spatial data used to represent real-world spatial data (Abbott and Argentati, 1995). By using GIS workstations located in high-traffic areas of the university, libraries can analyze requested information and determine how users can use services, providing them with the necessary information (Sweetkind-Singer MBA *et al.*, 2001) (Dixon, 2014; Hazlett, 2016).

University libraries can extend their reach by creating a network through web-based geographical information system (WEBGIS) that connects physical and non-physical resources while still maintaining their independence and taking common goals into account. GIS allows university libraries to create strong connections with one another by establishing a shared server for loading and using digital information. Essentially, GIS enables the identification and communication of digital information in a virtual space (Abbott and Argentati, 1995). The aim of utilizing GIS in libraries is to increase the number of users, develop a suitable collection, coordinate employees with user needs, take marketing actions, make the most of the collection and facilities and strengthen them by saving costs and developing shared resources in other sectors.

By utilizing GIS, libraries can provide users with detailed information on the location, availability and status of resources, using maps as the primary means of organizing and visualizing spatial data. GIS provides an interactive environment for presenting information in map form, enabling users to access the information they need easily (Arendt *et al.*, 2018).

Literature review

Several studies have been conducted on WEBGIS, including research done in university libraries such as Dixon (2014), March (2014), Gabaldon *et al.* (2006), Kiniken and Hench (2005) and Xia (2005).

In Dixon's study (2014), a GIS system was established in Arkansas university libraries called the MAP program, which stands for Essential Collaboration of Spatial Information System and University Libraries. This project was designed to cover local information only. The study was implemented through two main programs, Starting Hunt and GeoStar. Starting Hunt is a program for classifying geographic information on the web, while GeoStar is a comprehensive and integrated system for storing and providing geographic information. This model was accessible to all users at the Arkansas universities as well as local, national and regional users outside the university (Dixon, 2014).

In March's study (2014), the role and level of library services among users were examined using GIS and GPS on the University of Tennessee campus. This research aimed to provide library services to users using GIS and GPS technology as well as to expand virtual education and collaborate with other libraries on the University of Tennessee campus to help users with GIS. To better conduct this study, a survey was conducted among students and faculty members. The survey asked questions such as the library's need for GIS services, how the library and GIS services are related and how the community's need for GIS and GPS services is dependent on it. The feedback received from the faculty and students who participated in this survey provided valuable insights into improving library services using GIS and GPS technology (March, 2011).

Gabaldón and Repplinger (2006) carried out a study to explore and compare libraries that had implemented collaborations using a GIS with those that had not. To conduct the research and determine the level of GIS usage, they examined 103 libraries, of which 31 offered GIS services and 15 were planning to provide these services in the future. The process of providing services in these libraries was based on their characteristics. The study results indicated that libraries could collaborate and provide mutual support using GIS, prevent duplication of resource collection and offer their users information needs more efficiently (Gabaldón and Repplinger, 2006).

Kinikin and Hench (2005) conducted research to examine the use and implementation of GIS in small university libraries. The study examined the hardware, software, service levels and levels of educational and financial support for users and employees regarding GIS. The results revealed that even small libraries could provide useful and updated services to their users by using GIS and collaborating within a range (Xia, 2005).

Xia (2005) conducted research to explore and identify the location of items and information resources in a hypothetical library. In this simulated laboratory experiment, it was confirmed that GIS has the ability to display and analyze the spatial data of the library's information resource collections, along with presenting analytical results on maps with various details (Xia, 2005).

In the field of research conducted in public libraries, Arndt *et al.* (2018) addressed the issue of examining the existing infrastructures for implementing the GIS in the libraries under study. Using a researcher-made questionnaire, the study investigated these infrastructures, and the results showed that the studied libraries do not have the necessary infrastructures for implementing the GIS system, and they require more assistance from managers and officials (Arendt *et al.*, 2018).

Studies and literature reviews indicate that most research in this field has been conducted in western countries, and it seems that no research has been done in this area in Middle Eastern countries. Given the studies conducted in this area in other countries and the lack of similar research in the country under study, the aim of this research is to explore the possibility of creating a unified GIS library service system for the libraries of studied medical sciences universities.

Research objectives

Academic medical libraries play a vital role as centers for the provision and dissemination of specialized and vital information for the medical community and patients (Lyn Currie, 2002). Enhancing the quality of services provided by these institutions has a fundamental role in achieving society's goals in the field of public health. One of the most important characteristics of medical librarianship is providing services to students, faculty and staff in the field of medical sciences. Users of medical libraries, considering their busy schedules and the rapid pace of medical information updates, find themselves in a situation where they have a compelling need for library resources to solve clinical, research and therapeutic problems. Given the aforementioned factors and taking into account the geographical dispersion of libraries of studied medical sciences universities as well as the need to reduce barriers to quick and easy access to information resources, the aim of this research is to examine the feasibility of establishing an integrated GIS for the libraries of studied medical sciences universities.

Materials and methods

Study design and participants

This research was conducted using a descriptive survey method and a quantitative approach. The target population for this study includes the central and faculty libraries of University C (12 libraries), University B (11 libraries) and University A (nine libraries), making a total of 32 libraries. The research did not involve sampling, and the sample size is equal to the entire population.

Measures

The data for this study was collected using a researcher-designed questionnaire. This questionnaire was designed using the available literature as well as interviewing with librarians and GIS specialists. To determine the validity of the questionnaire, the content validity ratio (CVR) was calculated. For this purpose, the opinions of ten expert GIS professors were gathered for each question in the questionnaire, using three options: "essential," "useful but not essential" and "not necessary." The CVR formula used for calculation is $CVR = (n\_E - N/2)/(N/2)$, where n_E represents the number of experts who selected the "essential" option and N is the total number of experts.

Questions for which the calculated value of CVR was greater than or equal to 62% were retained in the questionnaire, while questions with values lower than 62% were removed. Thus, some questions were revised based on expert opinions or removed entirely from the questionnaire after considering the survey responses and the lack of necessity.

Initially, the questionnaire consisted of 49 questions, but after establishing validity, 15 questions were removed, leaving 34 questions in the final questionnaire. After confirming the validity, the reliability of the questionnaire was determined using Cronbach's alpha, resulting in a value of 0.77.

The final questionnaire includes 34 questions, designed in a quantitative format using a five-point Likert scale (Not at all = 0, Low = 1, Moderate = 2, High = 3, Very high = 4).

Data collection

The questionnaire was distributed in printed format to the managers of the participating libraries.

Statistical analysis

The investigated libraries were compared based on the overall obtained averages. If the universities' libraries scored between 1 and 25%, they were evaluated as "Very weak"; 25 to

50% as "Weak"; 50 to 75% as "Good" and 75 to 100% as "Desirable." The difference between the current status and 100% represents the existing gap in each infrastructure, which was assessed. Finally, the average of the obtained infrastructural scores for each university represents the overall average concerning the investigated infrastructure.

Data analysis was conducted using SPSS software, version 21.

Results

Table 1 illustrates the key components of the infrastructure for implementing a comprehensive WEBGIS in libraries.

The essential infrastructural requirements for the successful implementation of a unified WEBGIS in libraries encompass five fundamental aspects: human, technical, support, financial and legal (Shorabeh *et al.*, 2020). Collectively, these aspects encompass a total of 34 distinct sub-components (as shown in Table 1).

Items type		Items
Human infrastructure components	1	Familiarity with geographic information systems (GIS)
	2	Familiarity with Google Maps
	3	Familiarity with GIS software
	4	Familiarity with open-source and free GIS software
	5	Availability or attraction of specialized GIS personnel
	6	Presence of computer engineer or IT specialist
	7	GIS librarian
	8	Reservation of information resources in the library using GIS
	9	Access to information resources using GIS
	10	GIS training stations
Technical infrastructure components	11	Computer connected to the Internet in the library
	12	Local area network (LAN) in the library
	13	Online access to university campus and library locator map
	14	Full access to building and library maps of the university
	15	Peripheral computer hardware
	16	Printers and cartographers
	17	Web-based resources (such as databases, e-books and digital resources)
	18	Library resource metadata from the informatics department
	19	Equipped and powerful server
	20	Existence or production of specialized applications through smartphones and tablets
Financial infrastructure components	21	Funding for the purchase of necessary hardware and software
	22	Funding for the creation of required equipped spaces
	23	Funding for the purchase of high-speed Internet lines
	24	Funding for user and staff training
	25	Funding for software and documentation updates
Support infrastructure components	26	Conducting penetration tests
	27	Training on the use of new technologies in the library
	28	Online training on GIS usage
	29	Troubleshooting antivirus installation and computer equipment repair
	30	Increasing the capabilities of computer systems
	31	Updating GIS software and documentation
Legal infrastructure components	32	Signing agreements for interlibrary services
	33	Collaboration agreements between libraries
	34	Legal follow-up in case of violation of contracts

Source(s): Table created by authors

Table 1. Components of integrated spatial information system infrastructure in libraries of studied medical sciences universities

To assess the gap between the required infrastructural components for the WEBGIS system and the current status of these components, a meticulous examination of the current conditions was conducted. This evaluation was based on the managers' insights derived from questionnaires. Subsequently, the obtained results were compared against the desired level (signifying the attainment of 100% facilities in each aspect).

Table 2 demonstrates the current state and gaps in the infrastructures of the unified WEBGIS system in universities of medical sciences under study.

The findings reveal that in terms of the technical infrastructure required for implementing the integrated WEBGIS spatial information system in medical university libraries, University B has the highest average (64.55%), indicating the most extensive technical infrastructure among the surveyed universities. On the other hand, University C has the lowest average (59.17%), indicating relatively weaker technical infrastructure than other medical universities.

Regarding the maintenance infrastructure, the results show that University A has the highest average (51.39%), indicating better maintenance infrastructure, while University C ranks second with an average of 43.75%.

In terms of human resource infrastructure, University A has a higher average (45.83%) than other universities, indicating better human resource infrastructure. Conversely, University C has the lowest average (25%), suggesting a lower level of human resources available.

The results indicate variations in the availability of different components of the infrastructure among the libraries of studied medical sciences universities, highlighting areas where improvements are needed to bridge the existing gaps.

Furthermore, the financial infrastructure findings indicate that University A has a higher average (37.5%) than other universities, indicating a better financial position. Conversely, University C has the lowest average (27.08%) in terms of financial infrastructure among the surveyed universities.

Regarding the legal infrastructure, the findings indicate that University B has the highest average (43.18%), while University C has the lowest average (8.33%) in terms of legal infrastructure.

Overall, the average of all infrastructures indicates that University A has the highest average (46.54%), while University C has the lowest average (32.67%). In conclusion, University A has performed better in terms of overall infrastructure compared to other universities.

Infrastructures	University A		University B		University C	
Type of infrastructure	Current situation	Gap	Current situation	Gap	Current situation	Gap
Technical infrastructure	62.78%	37.22%	64.55%	35.45%	59.17%	45.83%
Support infrastructure	51.39%	48.61%	44.32%	55.65%	43.75%	56.25%
Human infrastructure	45.83%	54.17%	43.18%	56.82%	25%	75%
Financial infrastructure	37.50%	62.5%	31.82%	68.18%	27.08%	72.92%
Legal infrastructure	43.18%	56.82%	35.19%	64.81%	8.33%	91.67%
Overall average	46.54%	53.46%	45.41%	54.59%	32.67%	67.33%

Source(s): Table created by authors

Table 2. Gap between required infrastructures and current status in medical sciences universities A, B and C

These findings underscore the existing gaps in different infrastructure aspects and highlight the need for further improvements, particularly in financial and legal aspects, to enhance the overall infrastructure of the medical university libraries.

Discussion

The present study demonstrates that there is a gap between the current situation and the desired one in all the surveyed libraries, indicating the need for improvement and enhancement of infrastructures for the implementation of GIS.

The findings of this research indicate a shortage in terms of human resources infrastructure, specifically the availability of skilled personnel (GIS experts), computer engineers, IT specialists and experienced librarians in the field of GIS within the investigated libraries, particularly in the case of libraries of University C. While the previous studies conducted by Dixon (2014), Arndt *et al.* (20xx) and Kinikin and Hench (2005) emphasized the essentiality of having skilled human resources for the application and implementation of GIS (Arendt *et al.*, 2018; Dixon, 2014; Kinikin and Hench, 2005; Xia, 2004).

In various studies, the necessity of hardware and software requirements for a GIS has been emphasized (Arendt *et al.*, 2018; Dixon, 2014; Gabaldón and Repplinger, 2006; Kinikin and Hench, 2005; Wade Bishop and Mandel, 2010; Xia, 2004). However, the findings of the present research demonstrated that in terms of the required infrastructure for implementing a GIS in examined libraries, the technical infrastructure availability is in a better situation compared to other needed infrastructures. Among the technical infrastructure components, having computers connected to the Internet and a local area network (LAN) with online access to library sections and building maps is in a better situation compared to the other technical infrastructure components. Moreover, accessing bibliographic information from the informatics department of the faculty or university is also a prerequisite for implementing the spatial information system (Arendt *et al.*, 2018; Dixon, 2014; Pournaghi, 2015), while the findings of the present study showed that the investigated libraries have moderate access to it.

Regarding these findings, it seems that if there is an intention to implement a GIS system in the investigated libraries, the managers should pay more attention to the technological infrastructure and provide the necessary hardware, software and mobile applications for the implementation of such a system.

The findings of the current study revealed that the studied libraries are not in a desirable financial infrastructure status. Overall, there is a significant gap between available financial resources and needed facilities among the investigated libraries. The results of the Arndt and Kinikin study that has been done in western countries are not consistent with the findings obtained at the present study and indicate a higher level of financial resources (Arendt *et al.*, 2018; Kinikin and Hench, 2005).

The findings of the present study revealed that availability of the maintenance infrastructure of GIS is in an unsatisfactory situation in the investigated libraries.

The findings of this study revealed that the legal infrastructure of the investigated libraries is comparatively weaker in comparison to other infrastructural elements. Notably, the legal infrastructure of the examined libraries displays the most pronounced gap among the other infrastructural aspects assessed. One essential component of the legal infrastructure pertains to the establishment of formal agreements with other libraries, particularly concerning the sharing of GIS resources, GIS systems and related datasets. In his own investigation, Dixon underscored the importance of enforceable agreements among member libraries as a means to ensure enhanced service provision through the implementation of an integrated GIS system in library resources (Dixon, 2014).

Consequently, it becomes imperative for organizational managers to consider incorporating such agreements if they intend to proceed with the implementation of a GIS system. Such

agreements would effectively safeguard the rights of all parties involved in sharing information resources. It is important to acknowledge that there exist various technological, organizational, human and economic barriers to the establishment of information resource-sharing agreements among libraries. Among these barriers, the perspectives of managers are particularly influential and must be taken into account (Roubenheimer, 1998).

Conclusion

The present study revealed a significant gap between the current status and the desired status of implementing a comprehensive GIS in medical libraries across the surveyed universities. The findings of this research shed light on the shortages within the surveyed universities in terms of human infrastructure. The need for financial, legal and technical support to bridge the gap between the current status and the desired situation is highlighted in this study. Therefore, it is suggested that if there is an intention to implement a GIS system in the investigated libraries, the managers should pay more attention to these aspects and provide the necessary infrastructural supports for the implementation of such a system.

By focusing on improving the human, technical, support, financial and legal aspects, libraries can foster a conducive environment for the effective utilization of spatial information systems, ultimately benefiting academic research, education and overall information management in the field of medical sciences.

References:

Abbott, L.T. and Argentati, C.D. (1995), "GIS: a new component of public services", *The Journal of Academic Librarianship*, Vol. 21 No. 4, pp. 251-256, doi: 10.1016/0099-1333(95)90004-7.

Afshar, E. (2000), Planning and policy for collection development: application to a monograph collection at the state library of New South Wales, A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy at the University of New South Wales, University of New South Wales, Sydney, January.

A.J, GOZO (1985), Appropriate health sciences services for the third world in medical librarianship, pp. 239-244.

Arendt, A., Morris, A. and Stephens, M. (2018), "Public library use of geographic information systems in the United States", *Journal of Library Administration*, Vol. 58 No. 8, pp. 779-805, doi: 10.1080/01930826.2018.1516946.

Brown, J.S. and Duguid, P. (2000), *The Social Life of Information*, pp. 90-92, 10.1108/ws.2000.07949dae.002.

Cervone, F. (2008), "Managing digital libraries: the view from 30,000 feet; ITIL: a framework for managing digital library services", *International Digital Library Perspectives*, Vol. 24 No. 2, pp. 87-90, doi: 10.1108/10650750810875430.

Chen, J.S. and Tsou, H.T. (2007), "Information technology adoption for service innovation practices and competitive advantage: the case of financial firms", *Information Research*, Vol. 12 No. 3, p. 314.

Currie, C.L. (2002), "Difficult library patrons in academe: it's all in the eye of the beholder", *The Reference Librarian*, Vol. 36 No 75-76, pp. 45-54, doi: 10.1300/j120v36n75_06.

Dixon, J.B. (2014), "Essential collaboration: GIS and the academic library", *Association of Canadian Map Libraries and Archives Bulletin*, Vol. 119, p. 4, doi: 10.1300/J230v02n02.

Gabaldón, C. and Repplinger, J. (2006), "GIS and the academic library: a survey of libraries offering GIS services in two consortia", *Issues in Science and Technology Librarianship*, Vol. 48, p. 2, doi: 10.5062/F4QJ7F8R.

Hazlett, D.R. (2016), "Mapping out a plan product spotlight", *Library Journal*, Vol. 141 No. 5, pp. 74-75.

Jenkins, S. (2001), "Undergraduate perceptions of the reference collection and the reference librarian in an academic libraryNo Title", *The Reference Librarian*, Vol. 35 No. 73, pp. 229-241, doi: 10.1300/j120v35n73_01.

Kinikin, J. and Hench, K. (2005), "Survey of GIS implementation and use within smaller academic libraries", *Issues in Science and Technology Librarianship*, No. 42, doi: 10.29173/istl2006.

Lyn Currie, C. (2002), "Difficult library patrons in academe difficult library patrons in academe : it's all in the eye of the beholder", *The Reference Librarian*, Vol. 36 Nos 75/76, pp. 45-54, doi: 10.1300/J120v36n75.

March, G.H. (2011), "Surveying campus GIS and GPS users to determine role and level of library services", *Journal of Map and Geography Libraries*, Vol. 7 No. 2, pp. 154-183, doi: 10.1080/15420353.2011.566838.

Mash, S.D. (2008), Technology, forecasting, and ambiguity: a study of university decision making during the construction of twenty-first century academic libraries, Ph.D. thesis. The Learning and Technology Library.

Nazimoglu, Ö. and Yasemine, Ö. (2010), "Status of information technology applications in Pakistani libraries", *The Electronic Library*, Vol. 23 No. 3, pp. 350-364.

Pournaghi, R. (2015), Analysis of the physical behavior of library users in reading rooms through GIS : a case study of the central library of Tehran university, *International journal of humanities and social sciences*, Vol. 9 No. 4, pp. 1296-1302.

Ramzan, M. and Singh, D. (2009), "Status of information technology applications in Pakistani libraries", *The Electronic Library*, Vol. 27 No. 4, pp. 573-587, doi: 10.1108/02640470910979543.

Roubenheimer, J. (1998), "Interlibrary loans in new democratic societies- South African experiences", *Nterlending and Document Supply*, Vol. 26 No. 2, pp. 70-75, doi: 10.1108/02641619810213736.

Shorabeh, S.N., Varnaseri, A., Firozjaei, M.K., Nickravesh, F. and Samany, N.N. (2020), "Spatial modeling of areas suitable for public libraries construction by integration of GIS and multi-attribute decision making: case study Tehran, Iran", *Library and Information Science Research*, Vol. 42 No. 2, 101017, doi: 10.1016/j.lisr.2020.101017.

SPREMIĆ, M., ŽMIRAK, Z. and KRALJEVIĆ, K. (2008), "Evolving IT governance model-research study on Croatian large companies", *WSEAS Transactions on Business and Economics*, Vol. 5 No. 5, pp. 250-259.

Sweetkind-Singer Mba, J., Meredith, M. and Ba, W. (2001), "Supporting the information needs of geographic information systems (GIS) users in an academic library", *Science and Technology Libraries*, Vol. 21 No 3-4, pp. 121-129, doi: 10.1300/J122v21n03.

Wade Bishop, B. and Mandel, L.H. (2010), "Utilizing geographic information systems (GIS) in library research", *Library Hi Tech*, Vol. 28 No. 4, pp. 536-547, doi: 10.1108/07378831011096213.

Xia, J. (2004), "Library space management: a GIS proposal", *Library Hi Tech*, Vol. 22 No. 4, pp. 375-382, doi: 10.1108/07378830410570476.

Xia, J. (2005), "Locating library items by GIS technology", *Collection Management*, Vol. 30 No. 1, pp. 37-41, doi: 10.1300/J105v30n01.

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