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RESEARCH ARTICLE

“Kidney Health for All” – Study on the Role of a Digital Library that Works without the Internet– Can it Bridge the Digital Divide?

Palani Ravichandran^{1*}, Evamaria B Kaiser² and June d Sales³

¹Nephrologist, Saveetha Medical College, Chennai, India

²Director, Just1smile, Liechtenstein, India

³Software developer, Kidney Care Trust, India

ABSTRACT

Background: Health literacy is importantly recognized to combat the increasing incidence of kidney disease in the community and kidney health for all campaigns. Various kinds of digital platforms and tools are used to bridge the gap in health literacy to improve kidney health. Fifty percent of the world population is devoid of internet connection or poor connectivity. Digital library plays a vital role in digital literacy and this present study is done to see if a specially designed server can work without the internet.

Methods: A specially designed server that can connect with a digital device along with a regular internet-based server was loaded with digital library software. Devices with regular browsers were to access the server with the web address juxtguide.com. Users included the admin who had full control over the device and other users were divided into teachers group I $n = 25$ for online and group II, $n = 20$ for offline study, and they were allowed to upload various format digital files for their students to access. Students in the study group were $n = 250$ online and $n = 80$ in an offline group. They were assessed if they can access the digital material, search and also participate in chat functions with their teachers. Links were shared through social media for online mode.

Results: Teachers in both offline and online mode were able to access the server register and upload files in all formats like MP3, MP4, PDF, documents, links, blogs, and images, using digital devices including laptops or mobile phones. Students were able to communicate in the offline mode similar to the online mode with various digital devices. The offline server was portable and could run on a backup inverter power source and could run continuously with a hotspot range of 50 meters. The upload and download speed for the offline version was not affected whereas in the online mode, when in 2G the internet was of low speed, bigger files were not downloadable. The maintenance cost of the offline server was minimal compared to the online server.

Discussion: For the first time in the world, a server was converted to function in the offline mode, having the ability to synchronize with an online server that holds the same digital library software. All criteria of a digital library were fulfilled. In the offline mode, the device was also successful in two-way communication which no one could achieve to date.

Conclusion: DigiNet as a digital library device fulfills all requirements to be a cost-effective device for offline literacy development. It also gives new hope to surpass not only the health literacy barrier but also opens huge potential for its use in future research and education. Further research is to be conducted with regards to the extension of its range up to 12 km.

*Corresponding author(s)

Palani Ravichandran, Department of Nephrology, Plot 115 Raghavan Colony No 2 Link Street Jaffarkhanpet Chennai 600083, India

Tel: +91-904-200-1360

E-mail: ravirekha@hotmail.com

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Keywords

- Digital divide
- Health literacy
- Kidney health
- Digital library
- Offline literacy
- Internet deprived

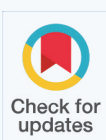
Introduction

The Covid-19 Pandemic, war, and human migration have massively driven people, organizations, and governments to digitalization and digital platforms [1-3]. This has also created a divide between people who have access to the internet and others who do not or only have a poor internet connection [4]. Making the

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disconnected people join the world of internet-connected is important for health literacy as communication and learning are important for healthcare providers. The World Kidney Day 2022 theme has included various tasks for kidney policymakers and emphasizes the growing importance of digital literacy in "Kidney Health for all" [5,6]. Kidney care professionals who work in areas with poor or no internet facilities find it difficult to be up to date. Our previous study presented the Neph E Club integrated learning model that focuses on sharing information through social media platforms. Therefore, using offline methods continuous to be attractive to many that joined the group as it remains a cost-effective and sustainable means for literacy development [7]. There still exist communication difficulties to reach field workers and gather point of care assessment data which are crucial in comprehensive kidney care programs and formulating policies.

Offline digital literacy is gaining more importance. Newer methods are devised to connect the unconnected population and keep it up to date [4,7]. Digital and health literacy is not possible without the digital library and for those who are not well connected to the internet the concept of an offline digital library was created. There, a device that has a huge reservoir of curriculum-based study materials is provided. This can be accessed anytime, irrespective of the internet connectivity [8].

To date, offline digital library literacy has some drawbacks. First, it only allows one-way communication. Second, limited users can access data at a time. Third, the software that many devices use neither runs on non-Windows-based computers nor can mobile devices be used to connect. Solutions to overcome these issues are still in the experimental stage. To be in line with the World Kidney Day declaration 2022 as the year of "Kidney Health for All" and to promote global teamwork and advance strategies in bridging the gap in kidney health education and literacy, this prospective study was done to explore the functional utility of the digital library model that can work in online as well as offline mode and also access the convenience of two-way communication and participation is possible for varied users.

Methods

The study defined the following as essential components of a digital library:

- 1) Content that can be digitalized and stored in various formats including PDF files, documents, PowerPoint files, MP4 videos, MP3 audio files, blogs, links to other videos, and images in both offline and online servers with the same software and same web address juxtaguide.com
- 2) The digitalized files thus stored be accessed by mobile phones, laptops, or desktops in both online and offline mode using a regular browser with windows as well as apple software.

- 3) The digitalized files are search engine enabled and downloadable.
- 4) Multiple users can access the offline digital library at the same time with no reduction in the download speed
- 5) The library access must be available 24x7 and portable with a backup facility when power fails for the offline version

Server: For the online version, a server was rented with the web address juxtaguide.com and for the offline version a mini-server was created with a special code to make it accessible offline with the same web address juxtaguide.com

Software: The digital library software developed for this purpose is named JUXTAGUDIE. The website can be accessed via juxtaguide.com, for both the offline and the online versions. The offline version is named Diginet for this study.

As shown in flow chart figure 1. Users will be grouped as

- A) Admin - has control over the entire software can upload delete and allow registration of users
- B) Teachers- Registered as a teacher comes with a right to upload files of their choice for their group of interest called students.
- C) Student- Those who can register but can view files and download the content and participate in chat function with group topic. This enables them to send feedback and two-way communication with teachers.

The analysis elaborated on the function of the offline digital library. It was compared to similar devices used. Its utility with regards to advantage and disadvantage is discussed looking at its usefulness in the advancement of kidney health for all or augmenting health literacy.

Results

As shown in table 1, $n = 25$ teachers were able to digitalize and upload library files successfully which included video, audio files, PDFs, documents, blogs, images, and links. 250 Students who participated in the study were able to register access the library in the online mode. They were able to communicate and download files uploaded by their teacher.

$n = 20$ teachers were able to participate in the offline model of digital library and $n = 80$ students within the range of the digital offline diginet were able to access the files and digital material without internet access. All 20 teachers were able to upload any PDF, MP4, MP3, blog, or images to the offline version DigiNet when within the range of the DigiNet using hotspot the largest file up to 250 Mb was set as a limit, and the largest file uploaded at less than 20 sec.

The digital device used included an apple iPhone, android

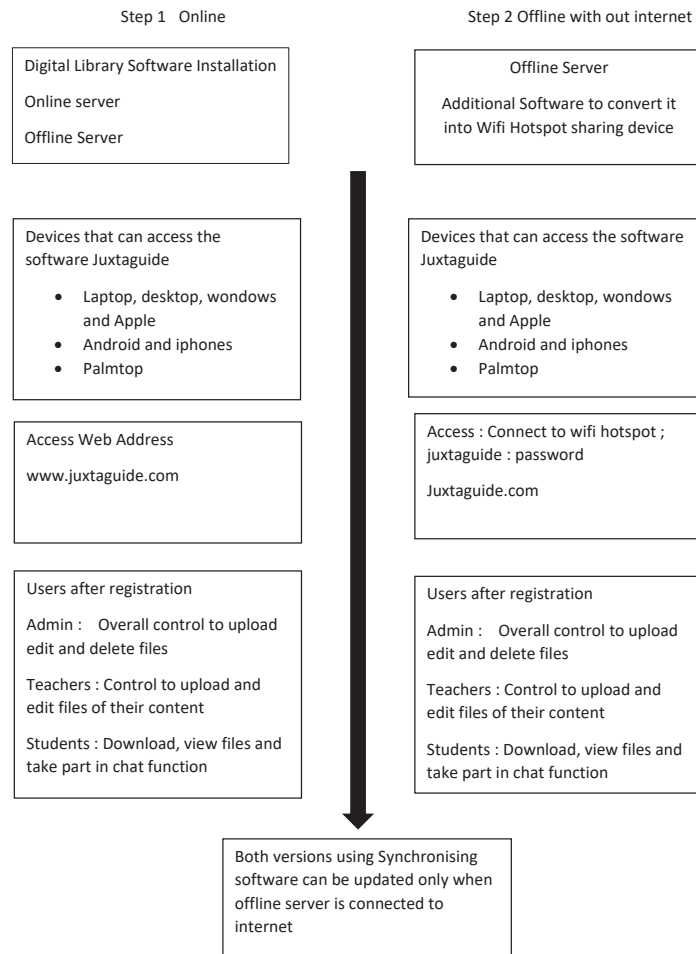


Figure 1 Flow Chart of the off line server with the digital library software and its relation to the online server with the same digital library software.

Table 1: Demographic details of the online version and the offline version of the digital library.

S. No.	TeacherOn-line n = 25	Teachers Offline mode n = 20	Students online n = 250	Student Offline n = 80	Online Internet speed 2G	Online Internet speed >3G	Offline No internet area	Admin
Digital Content								
1)PDF/Books	25/25	8/20	-	-	✓	✓	✓	✓
2)PPT	20/25	8/20	-	-	✓	✓	✓	✓
3)MP4	8/25	20/20	-	-	x	✓	✓	✓
4)MP3	4/25	12/20	-	-	x	✓	✓	✓
5)Blog	6/25	4/20	-	-	✓	✓	✓	✓
6)Links	8/25	0	-	-	✓	✓	✓	✓
7)Images	12/25	12/20	-	-	✓	✓	✓	✓
Content access								
a) Remote	25	0/20	195/250	0	Yes	Yes	No	Yes
b) 50 metres	6	20/20	0/250	80/80	Yes	Yes	Yes	Yes
MP4, MP3	-	-	-	-	x	✓	✓	✓
Other files	-	-	-	-	-	-	-	-
Complaints	-	-	-	-	Nil	Nil	Requires demo and training	Backups Add more functions
Adverse comments	-	-	-	-	Needs training	Needs training	Needs more demo	Multiple software can be added
Social Media Links					✓	✓	x	✓
Access Device								
iPhone	12/25	3/20	-	-	-	-	-	✓
Android phone	13/25	17/20	240	60	-	-	-	✓
Laptop	18/25	8/20	250	10	-	-	-	✓
Desktop	1/25	2/20	2	10	-	-	-	✓
Tablet	0/25	1/20	1	-	-	-	-	✓

ata safety	-	-	-	-	Open Insecure	Open Insecure	Secure	Secure Data safety
Cost in USD	-	-	-	-	-	7000	10000	-
Hardware Software	-	-	-	-	-	1000	6000 4000	-
Recurring cost	-	-	-	-	-	4000 500 per Mo.	10 per month	-

phone, laptop, desktop, and tablet. The majority of teachers 18/25, used laptops using windows or the apple operating system. They were also able to use iPhones and Android phones. Students were comfortable using any device and the majority preferred laptops and Android phones for the cost-effectiveness of these devices.

In the study period, non-registered users who were just visitors and able to access the content were 22,500 in an online version and nil in the offline version. The users were able to log into the server by sharing the link sent through social media including Facebook posts, Twitter, and whatsapp groups. When the internet speed was 2G users were not able to upload or download MP4, MP3, and certain large files. On the contrary, in the offline version, all files could be downloaded at a rapid speed, even when multiple users logged in at the same point of time. The offline version cannot be hacked, as data is safe and remote access is possible only to the admin who can access when there is internet available and the offline server is synchronized with an online server. The online version has no data protection and carries the same risks as any other website. The cost of the offline and online versions of the digital library set up was USD 7000 for the online version whereas it was 10000 USD for the offline version. The recurring usage, hosting, and server rental cost apply to the online version, apply to the online version, whereas there is nil recurring cost for the offline version. Links that were sent via Social Media in the online version were in PDF format with a hyperlink to the server library link. An offline server could be kept on for infinite hours and works on regular housing power supply and also worked with back up battery or UPS or inverter or solar powered. The present offline version had capacity storage of 2TB and at a time five hundred users can access the server in offline mode. Offline and online versions if need to be synchronized needs the offline server to be near an internet source and data can be transferred through special software for data processing and transfer of files from the internet version to the offline version. The offline version is also portable with the total weight of the device around 8 Kg.

Discussion

In this study, we were able to successfully run a program without the internet (offline). This must be seen in the backdrop of UNICEF's Data and Analytics Section report 2020 which finds that 2.2 billion children and young people aged 25 years or less – more than 65 percent of young people globally – lack internet access at home [9]. It is increasingly evident that this lack of connectivity is a barrier that prevents children and young people from accessing effective and interactive forms of learning to move forward. 'Digital

divide is the term used to describe inequalities in access to, and use of, digital technologies and content joining forces to develop appropriate and sustainable solutions that will truly benefit poor and marginalized communities. This is the need of the hour to narrow the gap [10].

Personal health literacy is the degree to which individuals have the ability to find, understand, and use information and services to inform health-related decisions and actions for themselves and others. Organizational health literacy is the degree to which organizations equitably enable individuals to find, understand, and use information and services to inform health-related decisions and actions for themselves and others [11,12]. In our present study, we included nephrology books and different materials. Also, health literacy guidelines formed an important tool whereby individuals and organizations were able to put digital material on a specially designed website that requires no internet connection, here described as "Offline Digital Library". This enables patients, care providers, individuals, or organization to digitally connect with the unconnected world and also gather data to analyze their literacy levels in line with the definition of health literacy that recommends innovations or new tools and software. Advances in telecommunication, including Social Media platforms, can be leveraged to enhance persons' and providers' education; The World Kidney Day declares 2022 as the year of "Kidney Health for All" to promote global teamwork in advancing strategies in bridging the gap in kidney health education and literacy [13,14]. Our own experience of successfully running an integrated Neph E Club education model published earlier shows that a combined offline and online education model is acceptable and preferred by kidney care providers. Still, connectivity remains a key issue in the previous study [15].

Our present study seeks to find a new way to reach and empower individuals, patients, and healthcare providers who are not connected to the internet. Though the trial was done to test the ability of nephrology and other related teachers to put up content on the website not only in online mode but more so in offline mode. This is crucial for health workers and doctors who work in low, middle and low-income countries that are deprived of internet.

The effective use of software can not only be used as a library resource in nephrology but also be utilized as a communicative tool for interactions between groups thereby enabling it to collect data and analyze the literacy levels existing. The present study outlines that it is possible to integrate the online and offline access to reach all places which are devoid of internet connectivity or where net speed is slow (2G network) that hampers file sharing, uploading,

and downloading larger files.

Health literacy can be considered a modifiable risk factor for socioeconomic health disparities. Enhancing the level of health literacy in the population and making health services more accessible to people with low health literacy is a means to reach greater equity in health research. This is vital to study the role of offline digital literacy concerning health literacy. The latter is lacking due to the non-availability of devices and software. There is an ongoing and growing concern for students to be aware of digital literacy and seek new technologies and learning methods. Our study thus gives an additional opportunity to use offline education that draws further interest in health technologies. This represents enormous promise in the building of digital health literacy skills and improved health outcomes in patients with cardiovascular and other chronic conditions [16-18].

Though the majority of libraries are getting converted into digital libraries, access to educative material is limited. Every effort is being made to digitize and promote digitization, particularly in libraries. There, information is essentially harnessed for sharing with communities of users with different information needs [19,20]. The ocean of books and information available makes someone drown and also restricts teaching videos or audios that are frequently updated on the internet including social media but are absent in regular libraries which are not updated. Our study highlighted how a digital library software could be used even as an offline version and also convey individualized information sharing, which makes it a reliable platform for remote students to engage meaningfully in two-way communication processes. The ability of teachers to give filtered teaching material to the students and do constant updates by integrating social media makes it unique learning and teaching experience.

Major organizations and NGOs have tried many

systems to impart offline learning methods to bridge the digital divide but they were not successful in two-way communication. The closest was a modular offline learning education assessment platform called MOLEAP which also advocates further technical development, research, and refinement to bring it fruition so it can 'just work' in the harsh and unforgiving environment of remote communities and developing countries to be of use to those most in need and highlighted need to find innovative ways to enable those on the fringes to be able to engage in learning experiences of the 21st century or we risk an ever-widening digital divide [4].

In the present study, we were able to demonstrate for the first time in the world an offline server that has a digital library software similar to the online version which can receive and disperse data to the users. The advantage is that it works by using the same web link juxtguide.com which is used for the online version. This gives additional ease of use in operations.

Most offline systems work in a windows-based operating system and not on other operating digital devices whereas our DigiNet can work in both, windows and also on apple based operating systems and also on various mobile devices. Thereby giving an edge over other existing devices like D-Link, Tech by Tech microcomputer, Lexis Nexis digital library, Mintbook, Ustad mobile, and SolarSPELL offline digital library (Table 2). All of these devices are storage devices and not server based. The present DigiNet system is a server that is specifically programmed to link devices in an offline mode with internal software arrangements. Thus, the system can upload, store and download data. Multiple users can work on the system with no reduction in the speed of access. The system is upgradable in the future so it can reach a distance covered of 12 km with a larger storage space made available.

The major complaints and suggestions received were

Table 2: Comparison of various offline digital library devices and DigiNet.

S. No.	Name of device	Access	HSR	Users	Down Load Speed	Continuous Usage	Cost USD	2 Way com.
1	D-Link	App- based, WiFi hotspot	Limited	Limited	Reduces with multiple users	Yes	100	No
2	Teach by Tech microcomputer	WiFi hotspot	Limited	Limited	Reduces with multiple users	No	NA	No
3	Lexis Nexis Digital Library	Downloads from servers for offline viewing later on	NA	App based, Single user	NA	Yes	NA	No
4	Mintbook	Stored content	NA	Single user	NA	Yes	NA	No
5	Ustad Mobile	Stored content	NA	App based, Single user	NA	Yes	NA	No
6	SolarSPELL Solar Powered Offline Educational Learning Library	WiFi hotspot, pre-stored content in SD card	Limited	Yes	Slow	No	NA	No
7	DigiNet	WiFi hotspot, connects with Web browser and any device	Currently 50 m,	Up to 1000 users at a time, extendable	Fast	Yes, non stop, and runs with backup power	7000	Yes

about getting accustomed to the software functions and understanding its use. Both requires initial training. The offline device also functioned well with any type of portable power source like UPS or power converter source from a vehicle. The present study sheds light on the important technical development where the offline server can be accessed with a web address like the online server. This has never been possible before. A further innovation is the ability to synchronize with the online version which then is useful to integrate offline data online. The server provides data security. Further, it is useful in internal communications within a group of doctors who can store certain patient-related teaching videos that neither can go online nor breach privacy norms. Though social media has completely revolutionized medical education and the dissemination of information in the nephrology world in the last decade making it the ultimate “medical lounge” still information pollution, absent peer review and bots putting up fake information makes “wisdom of the crowd” to decide genuineness of information [21]. Offline literacy overcomes this issue and can also be used in institutions and departments to store certain patient information that can be accessed at any time from the library with the additional option to archive, catalog, or quickly retrieve conversations.

Restrictions in this study are that this device was loaded with a library software was that this device to see if files can be shared “without internet” using the web address juxtguide.com. In the current study, we used it to see its usefulness in augmenting nephrology education among low and middle-income students who do not have adequate access to internet or a library. Further study is done to see its function to hold multiple software and to increase the range of coverage.

Conclusion

The present study gives new hope to bridging the digital health equity gap. The digital offline device DigiNet with its library software allows remote learners and teachers to equally participate in an increasingly digital intensive world, regardless of their current level of internet connectivity. Future improvements allow widening the scope towards achieving the goal of kidney health for all.

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