

Implementation of e-learning Platform for Increasing Digital Health Literacy as a Condition for Integration of e-health Services with PHR

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Abstract

Digital healthcare self-management education has the potential to increase the necessary knowledge and skills for the improvement of health outcomes for citizens, especially patients with a disability and chronic diseases. If the implementation of the e-health concept has to be considered, it is obvious that there is an emerging need for increasing the digital health literacy of the population. First, the digital health literacy of healthcare and medical staff has increased and in the second phase, disabled people, chronic disease patients, and the elderly have to be educated about their digital health literacy in order to use e-health services. The use of information and communication technologies provides an effective and efficient way to deliver health content prepared by medical staff as well as psychologists. The paper highlights the process of implementation of the e-learning platform for digital health literacy – Atutor, an open-source learning content management system suitable for a wider population with implemented WCAG compliance, and the challenges arising during its implementation

Keywords

Personal Health Record (PHR), patient-centric data integration, cloud-based PHR, Internet of Medical Things, medical sensors

1. Introduction

Managing care for the growing elderly population and increasing number of patients with chronic non-communicable diseases requires effective measures such as involvement and empowerment of patients in self-care. Additionally, the coronavirus (COVID-19) pandemic had a huge impact on the normal lives of

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people and led to the advent of a new normal. People increasingly use digital technologies and the Internet to do every day professional, private as well health activities. The project Cross4all addresses the e-health challenges in the cross-border area, taking into consideration the problems of creating a PHR (Personal Health Record) for patients from two national healthcare systems where the patient is the data owner. The proposed architecture is cloud-based and distributed, in order to support data collection from different types of sources and collected in different ways such as patients' healthcare data, medical practitioner data, data collected from biomedical devices, sensors for measuring vital signs of life, many times collected from remote patients, the disabled population, children and elderly people [1].

The increased use of internet access and use of digital technology leads to people relying on received and sent health information. The potential for health technologies to be the catalyst for significant advances in healthcare cannot be questioned, however from a scientifically standpoint, there is still much to be done to create platforms and systems that activate and engage those who would benefit from knowing before health issues arise and are too far along to be reversed or effectively managed [2]. There are also challenges when it comes to the systematic assessment of the reliability of health information and unreliability has a negative impact. The use of social media requires analytical skills to evaluate various information in a smart way.

Today, digital literacy has been dubbed as a fourth literacy, after reading, writing, and mathematics are considered the cornerstone of being literate.

There are many advantages to having high-level digital Health literacy skills—they allow patients to operate well within the health care system and find better care by using online information more effectively, reduce waiting periods and improve communication with healthcare professionals. Research has found a positive connection between digital health literacy and joint patient–medical professionals' decision-making, [3] as well as clear advantages for patients' decision-making styles [4].

The e-learning platform as a part of the Cross4all project makes a positive impact, increases the participants' e-health and healthcare digital competencies, and speeds up the process of healthcare self-management.

The paper describes the implementation of an e-learning platform available cross-border in a real environment. After the introductory section, the second section presents research results regarding the digital and health literacy of the pilot project participants. In the next section, the paper considers some points of project aim and purpose, prerequisites, and security and safety standards, taken into account in the phase of LMS (Learning Management System) selection. The next section describes some of the challenges and obstacles and presents real

solutions. The concluding section contains supportive concluding remarks and proposes some project improvements.

2. Digital health literacy

The Internet abounds with health information. For an illustration, about 3,770,000 results are returned by Google when searching for “blood pressure” and about 3,910,000 results when searching for “diabetes”.

In order to use digital information, three preconditions need to be met: access to a computer and high-speed internet; the digital literacy skills needed to use the computer; and necessary skills to evaluate online health information resources.

Digital health literacy is a set of basic skills acquired through effective digital technology to search, understand, and evaluate an individual’s health information. This relates to the use of digital health technology in the online environment and to apply the knowledge acquired [5].

The level of digital literacy of the population in the border region is significant. In order to determine how and to answer other important questions, a survey was conducted.

The analyzed research results show that 79% of adults use a smartphone, tablet and/or computer. Respondents rated the internet connection as satisfactory and good 73.4%, while 23.2% from very good to excellent, and 3.4% poor or have no Internet access at all.

57.9% say that they used digital devices to look online for digital health content within the past year. 34.4% find easy information and services related to health, 34% find information with difficulty and 31,6% say that they do not find such information and data (Figure 1). The language was highlighted as one of the problems in accessing the necessary health content (81.6%). They prefer health content in the Macedonian/Greek language, their respective mother tongue. The respondents who access the digital health content find it helpful to find information regarding their health problems and possible. Some of them say they use the internet as a de facto second opinion.

Most of the respondents, 64.2%, believe that the accuracy and importance of the information depend on the source of the information, and the information obtained through the Internet sometimes is incomplete, confusing, and in some cases inaccurate. Only a small percentage 25.3% check the accuracy of the information and 10.5% do not find important and useful digital health information (Figure 2).

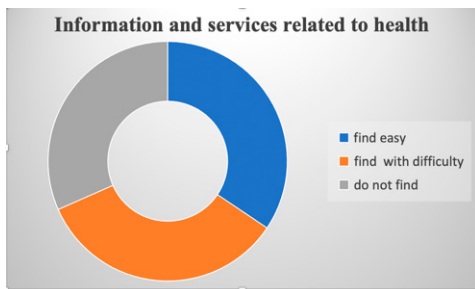


Figure 1: Access to health information and services

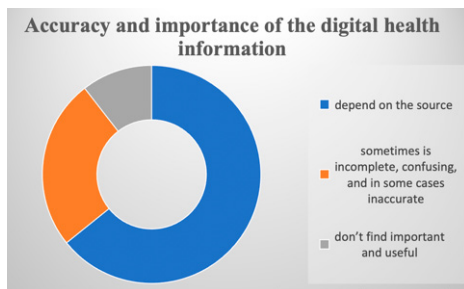


Figure 2: Accuracy and importance of digital health information

Following the results obtained from the research, we estimated that within the Croos4all project it is most appropriate to develop a digital learning platform that is easy to use and that incorporates the motto of the project a Cross4all promoting safe aging, early prevention, and independent living for all.

The digital learning platform will help project participants to know how to use the mobile application as well as help citizens from cross-border regions to use technologies to manage learning, keep up with any changes and encourage them to seek knowledge by themselves, from digital media and social media [5].

The e-material was created and posted on the e-learning platform, taking into consideration the needs of disabled people, the elderly population, and children. This platform is free, accessible from anywhere, on disposal to the population with many video materials, presentations, and brochures that have to support the project's aim of increasing the population's e-health and digital health literacy [6].

The manuals about the new workflow and mobile applications, tutorials, and technical support needed for integration of e-health Services with PHR during the pilot project were prepared by two project partners (the Aristotle University of Thessaloniki, Department of Medicine and University "St. Kliment Ohridski" – Bitola, Faculty of Information and Communication Technologies). The health content about diabetes, cardio, Covid-19, and psychology, posted on the digital platform was prepared by medical professionals (Figure 3). The content is available in three languages: English, Macedonian, and Greek.

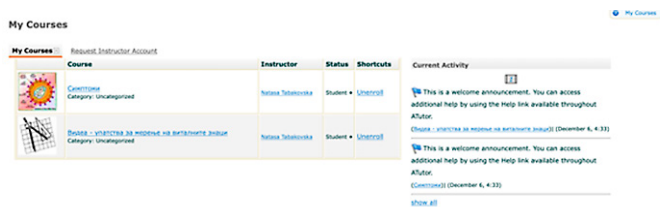


Figure 3: Available courses on the Cross4all e-learning platform

Several tasks need to be completed before the e-learning platform is implemented choosing the most suitable LMS; UI (User Interface) compliance with the WCAG (Web Content Accessibility Guidelines) standard; preparation of the content and upload to the platform; defining content groups and menus; content placement and preparation of documentation.

3. Analysis of different learning management systems

Learning Management Systems (LMS) are considered as platforms for e-learning, taking into consideration their capability and accessibility from different points of view.

LMS have big potential for continuous improvement of digital and health literacy. There is a plethora of available LMS, and each one has different features, which are tailored to the different needs of the target groups. To find and choose the most appropriate LMS is a very important task, and it has a big impact on health literacy improvement [6]. Although there are many user-friendly developed LMS algorithms to help make choosing the best LMS easy, choosing the appropriate LMS in accordance with the WCAG standard, that is aimed to increase the digital and health literacy of the population of the cross-border area in of Cross4all project of IPA2, was a challenging task [6].

We made research and analyzed some respectable e-learning systems with W3C's Web Accessibility principles, defined by ISO 9241-171:2008 standard as priority (in mind). In the research, considerable attention was dedicated to the following four principles: Perceivable, Operable, Understandable, and Robust in order to provide the basics of web accessibility with 12 guidelines for the authors [7]. For each guideline, we provided testing according to WCAG 2.0 for three levels of compliance: A (lowest), AA, and AAA (highest) [8].

The analysis was performed on the latest public version of the respective Learning management systems (LMSs) such as Moodle, Eliademy, Docebo, Sakai, and ATutor, considering the WCAG 2.0 standards and criteria.

Each of the analyzed LMSs presents a different learning platform with unique features. Although the accessibility of learning management systems is improving, there are still significant challenges for people with disabilities [9]. According to the Cross4all requirements, the criteria from WCAG 2.0 Level AA compliance need to be satisfied.

Our further testing continues with the evaluation of the criteria of Level AAA for Moodle and ATutor, as these two systems are particularly prominent in terms of availability for people with disabilities in the previous evaluation [9].

WCAG 2.1 provides 17 new success criteria for different levels of compliance. The five new success criteria for level A: Character Key Shortcuts, Pointer Gestures, Pointer Cancellation, Label in Name, Motion Actuation. Seven respec-

tive criteria from Level AA: Orientation, Identify Input Purpose, Reflow, Non-Text Contrast, Text Spacing, Content on Hover or Focus, Status Messages; and five new criteria for Level AAA which is the highest and also least common level of compliance: Identify Purpose, Timeouts, Animation from Interactions, Target Size, Concurrent Input Mechanisms. All these criteria were compared in a real environment, on publicly accessible latest versions of Moodle and ATutor [10].

ATutor was selected as more suitable for the project activities of Cross4all IPA2, as an LMS that has to satisfy the demands of elderly people, children, people with chronic diseases as well as people with disabilities in order to increase e-health and medical digital literacy for the cross border region, including all partners' contribution [10].

4. Implementation challenges

ATutor, as an open-source LMS, gives the opportunity to develop and manage online courses, and to create and distribute interoperable e-learning content. ATutor is designed with accessibility as a priority. The newest version of ATutor is adding course gamification and refinements [11].

This LMS has a user-friendly UI, which makes it an ideal tool for beginners as well as people with disability. It has integrated one of the general principles that underlie the Convention on the Rights of Persons with Disabilities to provide access to all aspects for all people on an equal basis. It means “universal design”, design usable by all people, to the greatest extent possible, without the need for adaptation or specialized design [12]. Besides the Accessibility features which are the most important attribute for people with disability and elderly people, it has the best communication tools with a user-friendly interface and encapsulates multimedia help of Handbook. Moreover, ATutor has the user-friendly JavaScript WYSIWIG editor, which is appropriate for a wide community of users and has many useful features differently from others, such as a glossary, users online and search bar, latest discussion topics on the forum, and a site-map with an ARIA tree [6]

The implemented e-learning platform (<http://atutor.cross4all.uklo.edu.mk/login.php>) contained much public content: manuals about the new workflow and mobile applications, tutorials, technical support, and health content. All contents are available in three languages: English, Macedonian and Greek languages (Figure 4).

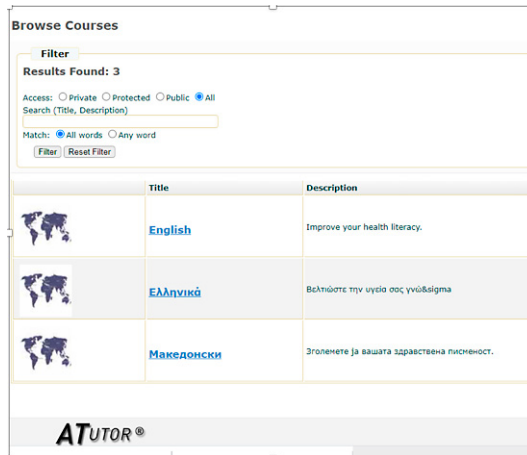


Figure 4: Ability to choose between three languages

The users can register themselves, log in on Cross4all LMS and improve their e-health literacy in many areas such as cardiology, psychology, diabetes, how to use gadgets for measuring vital signs, and so on. The selected content can be viewed online or be exported – downloaded and viewed offline.

The user can change elements of their personal profile, can enroll in courses that they are interested in, can control which versions of content are displayed, if for example, the primary version is not accessible to them, or they prefer an alternate format. Also, users can develop a network of contacts, create and participate in social groups, develop a social profile and use different gadgets (a user can add some of the available applications to their Social Networking environment that provide a whole range of potential networking functionality). Additionally, they can create “My Contacts” – a list of people in the user’s social network.

Although the platform offers a number of possibilities, during the implementation as well as during its use we faced some challenges.

Some of the problems that we were facing during implementation include lack of documentation or outdated documentation, installation instructions that were for older and legacy systems, and older versions of operating systems. One of the things is that we were trying to virtualize/dockerize the application for it to be easily movable to staging and production environments. ATutor supports several types of databases and we decided to go with the MySQL database.

The system has one big problem when it is not properly shut down. Then, it loses some of the configuration information, and then it needs to be reverted to some previously configured valid version. The additional downside of using a not properly configured MySQL database was that it did not support utf-8 character

sets, we had significant challenges regarding implementation of the Cyrillic, and Greek alphabet and we needed to manually configure and provide support for such alphabets. Atutor is not an up-to-date system and does not provide the latest support for new versions of internet browsers, the latest version of the system has been released in 2018.

Because of the complexity of healthcare, and a large number of health topics, we are faced with the problem of finding digital and objective information accessible to both healthcare providers and patients. Content for patients with objective and irrelevant health information is the most requested to be prepared by medical professionals.

Medical professionals are pressed to integrate health IT into their jobs, while also trying to stay up-to-date with emerging technologies. They often have to deal with low-quality, bugged, or inefficient software and technologies that further decrease the amount of time they can spend with their patients [13]. Healthcare professionals are supposed to provide help to a big number of patients in a given time frame. Additionally, healthcare professionals were overloaded due to the coronavirus (COVID-19) pandemic. They are frustrated that health IT requires their increased engagement, needs long data entry, decreases the amount of time spent on health digitalization processes, and disrupts it instead of helping their practice.

One more challenge we faced with was the older patients' lack of digital literacy.

5. Conclusion

Designing and implementing an e-learning platform for increasing digital health literacy in the Cross4all project is one of the components of the digital health system (which we are keen to be just one part of a larger health system in both cross-border countries). The process to build and sustain a functional platform is made up of several stages: choosing the most suitable LMS; UI compliance with the WCAG standard; preparation of the content upload platform; documentation preparation and platform maintenance.

The dynamic nature of technology and healthcare made the process of implementation and maintenance non-linear and iterative. Some of the challenges we faced sometimes had to revert to some previously configured valid version, regarding implementation of the Cyrillic and Greek alphabet and the need to manually configure and provide support for such alphabets. Another big challenge is the preparation of health content. This needs some systematic solution. Additional patients' training of platform usage was needed.

In future work, we have to work on a digital learning platform that will feature special courses related to health literacy. This means the ability to obtain,

read, understand, and use healthcare information in order to make appropriate health decisions and follow instructions for treatment. For example addressing or solving various health problems, and courses related to digital health I health literacy (set of skills, knowledge, and attitudes that a person needs in order to (a) seek, find, and appraise health information and services from electronic sources, and (b) to find, select and make effective use of available tools (PHRs, devices, mobile apps, etc..

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