Designing Open Server for Educational Question Resource

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Abstract. Information technology has become a vital component in modern teaching. Today’s educators have significantly depended on the internet to increase the quality of the education especially in accessing new content for teaching material. Hence, it is important to aid the teacher by providing a well-structured and high-quality content. The Open Educational Resource movement, initiated by UNESCO in 2002, is aimed to perform the aid for teachers.
In this paper, we propose an architecture of an open server for educational questions. The purpose of the system is to provide freely-accessible high-quality questions that can be used by educators to evaluate the study result. By providing enough information regarding the content, teachers can develop a well-structured test to be used in their classes.

1. Introduction
In modern classroom, the role of information technology is vital to increase the quality of the education process. There are numerous hardware and software intended to aid educator to perform and manage their education process. Modern teacher/lecturers nowadays are required to be fluent in using technology, such as multimedia content, internet, and classroom management system, to enhance the effectiveness and efficiency of education process. Moreover, there is a tendency to use education software does not only focus on tools to aid the formal education process, but also focus on the informal process. There are numerous studies on how to aid student’s formal education by using informal education process such as games, animations, and interactive multimedia (most notably VR and AR). Most of the time, research in this area focus on developing an interesting and entertaining study experience. This condition increases the demand of educational software that may help students and teachers to improve the educational process.

Aside from enhancing education experience, information technology can also be used to increase the reachability of the education itself. One of the biggest issues in education is the distribution of quality across the globe. Ensuring students in rural areas to receive a proper education is still a problem yet to be solved. The cost of distributing books and classroom supply combined with the lack of human resources available to maintain the education process are two of the biggest obstacle for education institution to reach rural areas. However, The use of information technology can be an effective solution to solve this problem. Content digitalization and low-cost network infrastructure are two of the most promising solution to solve this problem.

Realizing the importance of information technology to fuse into our education process, UNESCO declared and Open Educational Resource initiative and published a book as a guide to support the creation of free educational content. The book titled “A Basic Guide to Open Educational Resources..."
(OER)” contains details regarding the definition, properties, and reference in creating a free educational resource [1]. The purpose of this initiative is to significantly increase free educational resources (such as content, syllabus, curriculum, and system) thus allowing government or education institution around the globe to perform a high-quality education.

Our research revolves around this initiative. In this paper, we propose an idea to create an open server for educational question resource. The objective of this research is to create a server filled with educational content (which is, in our case, questions) freely accessible to any educational institutions, software developers, and even ordinary users. The purpose of the system is to ease the distribution of high-quality educational questions content to users which can be used as part of educational software or part of the exam in the classroom.

2. Related Works
Considering the importance to apply information technology in a modern classroom, many researchers have developed a study regarding educational software. There are various approaches proposed to fuse technology in the education process. Some research argues that video game is an effective tool to perform education. A work by published De Lope et al [2] describes how to develop effective video games as a tool to perform an education. He proposed and detailed the methodology and key factors to design a good educational game. Similar to this study, Bergervoet et al. perform a study to find the relation between game behaviour and its player that can be used in developing educational games [3]. In this research, Bergervoet argues that educational video games developer, instead of simply adding educational content on the game, should understand the purpose of the software and how the educational process should go. Using these facts, a developer should then design behavior to achieve the purpose. Simply put, both research believe that video game can be a very effective educational tools given it is designed and implemented properly.

However, as proposed by Marklund et al., implementing video games as part of formal education is another challenge [4]. Games are designed to be entertaining and it is unsuitable to formal education environment where student are expected to be focused during the process. Yet, the author also argues that games can be a potential tool to aid the formal education. Despite the obstacle previously explained, there are many researchers developed an educational game and observe how it educate its user.

Another interesting topic in educational software development is to increase the reachability of the content. Most researches that focus on this topic target rural areas where education process is a big challenge due to the lack of available resource. Numerous solutions were proposed to tackle this problem. Some solutions propose on low-cost data transmission technology used to transmit the data [5]–[7], others focus on the content [8]–[10] and software development [11]–[15].

3. Requirement Analysis
Before we go through the design of the system, we are going to analyze the purpose and list the requirements based on it. As previously stated, the idea of this initiative is to provide open content for educational software. Based on this fact, we came up with a list of basic requirements of the system. We will go through each requirement and propose a solution to fulfill it.

3.1. Open System
The most important requirement of our system is the content must be openly available. Developers and applications should be able to access the content without requiring authorization. However, while the content can be accessed freely, authentication is still a required feature. Not only it allows developers to track their requests, but also it allows us to track users/applications with good behavior and able to grant more privileges to those users.
3.2. Accessibility
While the system offers full access to the content, some limitations are needed to be maintained. Users must not be able to manipulate (insert or edit) the content directly to avoid faulty or inappropriate content. It is important to provide a regulation regarding the user’s accessibility of the content.

However, we must keep in mind that ease of access is a vital feature for the system. We should flexibility of the users to access the content. Users, especially software developers, must be able to manage the content delivered to the application. Thus, our system must provide a certain amount of options to ease developers/applications to access the content efficiently and effectively. Providing a method for users to fetch a certain amount of content with specific properties is important to avoid request or data traffic redundancy.

3.3. Well-Structured Content
One of the important keys to managing educational content is to properly categorize the content based on the subject and difficulty. Therefore, every content in our system must be assigned to the property to define the level of the content such as both subject and difficulty. Moreover, there should be a guide or proper documentation regarding these two variables for developers to avoid confusion amongst the developers. While it is easy to find content based on the education level, measuring its difficulty can be hard and requires advice from teacher or expert in education.

3.4. Well-Documented API
As previously described, users’ access must be properly bounded to avoid inappropriate access. However, this boundary should not discourage users to use the system. Thus, it is important to aid users regarding the accessibility of the system. One way to do this is to provide a well-documented API as a guide for users to access the system.

4. System Design
We are currently in the early stage of the development process. Our first objective is to build a design that can effectively fulfill the requirement listed above. The figure below defines the basic design of the system.

![Figure 1. The Design of Open Educational Question Server](image)

We will be using Open Educational Question Repository (OEQR) as the name of our system. The system itself is split into three main parts: Database, Server, and Front End. The core of the system lies in the database where it contains all the educational question content. Depending on the type of the content, the design of the table varies. However, as previously stated, each question has to be
categorized properly. Hence, it is important to make sure that all the tables contain columns for categorization.

To access the content, users or other applications will have to send a request to the OEQR Server which is responsible for processing the request and returning an appropriate response based on the parameter. In the current design, a request to the server is formed as a simple HTTP request. Additionally, we are planning to create a front-end application that acts as a web-based application where users are able to browse through all the content and fetch the desired content.

5. Conclusion and Future Works

In this paper, we proposed a design for Open Educational Question Repository. As suggested by the name, the system contains a variety of questions, freely accessible for users. We listed the definition and purpose of the system, followed by the requirements. This paper is the early phase of the project and our research team will use this paper as part of the references for future development.

One of the obstacles we have foreseen in the future is the development of the content. While the early design of the system is simple to be implemented, developing high-quality content is challenging. We are planning to collaborate with education experts and institutions to develop high-quality and well-organized contents.

References

[1] N. Butcher, A. Kanwar, and S. Uvalić-Trumbić, A basic guide to open educational resources (OER). Vancouver; Paris: Commonwealth of Learning ; UNESCO. Section for Higher Education, 2011.

[2] R. P. De Lope, N. Medina-Medina, R. M. Soldado, A. M. Garcia, and F. L. Gutierrez-Vela, “Designing educational games: Key elements and methodological approach,” in 2017 9th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games), Athens, Greece, 2017, pp. 63–70.

[3] E. Bergervoet, F. van der Sluis, B. van Dijk, and A. Nijholt, “Let the Game Do the Talking: The Influence of Explicitness and Game Behavior on Comprehension in an Educational Computer Game,” in 2011 International Conference on Cyberworlds, Calgary, AB, Canada, 2011, pp. 120–127.

[4] B. B. Marklund, P. Backlund, and H. Engstrom, “The Practicalities of Educational Games: Challenges of Taking Games into Formal Educational Settings,” in 2014 6th International Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES), Valletta, Malta, 2014, pp. 1–8.

[5] V. B. Dharmadhikari, “Creating Educational Lecture Videos Compatible with Streaming Server Using Low Cost Resources,” in 2011 IEEE International Conference on Technology for Education, Chennai, India, 2011, pp. 116–120.

[6] B. Mayeku, J. Kilwake, and F. Bertarelli, “Use of low cost wireless communication technology for education in rural Kenya,” in Proceedings of the 4th ACM Workshop on Networked Systems for Developing Regions - NSDR ’10, San Francisco, California, 2010, pp. 1–2.

[7] C. Rey-Moreno, I. Bebea-Gonzalez, I. Foche-Perez, R. Quispe-Tacas, L. Líñan-Benitez, and J. Simo-Reigadas, “A teledicine WiFi network optimized for long distances in the Amazonian jungle of Peru,” in Proceedings of the 3rd Extreme Conference on Communication The Amazon Expedition - ExtremeCom ’11, Manaus, Brazil, 2011, pp. 1–6.

[8] M. Molapo and G. Marsden, “Health education in rural communities with locally produced and locally relevant multimedia content,” in Proceedings of the 3rd ACM Symposium on Computing for Development - ACM DEV ’13, Bangalore, India, 2013, p. 1.

[9] E. del C. Valderrama Bahamondez, C. Winkler, and A. Schmidt, “Utilizing multimedia capabilities of mobile phones to support teaching in schools in rural Panama,” in
[10] Qiang Ge, Xi-cheng Peng, and Mao Chen, “Application of animation of Super Sketch-Pad on mathematics education,” in 2009 4th International Conference on Computer Science & Education, Nanning, China, 2009, pp. 1790–1795.

[11] J. Uchidiuno, E. Yarzebinski, M. Madaio, N. Maheshwari, K. Koedinger, and A. Ogan, “Designing Appropriate Learning Technologies for School vs Home Settings in Tanzanian Rural Villages,” in Proceedings of the 1st ACM SIGCAS Conference on Computing and Sustainable Societies (COMPASS) - COMPASS ’18, Menlo Park and San Jose, CA, USA, 2018, pp. 1–11.

[12] R. P. De Lope and N. Medina-Medina, “Using UML to Model Educational Games,” in 2016 8th International Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES), Barcelona, Spain, 2016, pp. 1–4.

[13] I. Ghaznavi et al., “VillageApps: a platform to educate underprivileged communities in their mother tongue,” in Proceedings of the Seventh International Conference on Information and Communication Technologies and Development - ICTD ’15, Singapore, Singapore, 2015, pp. 1–4.

[14] Xiaojun Wang and Daohua Huang, “Research on the architecture of Open Education based on cloud computing,” in 2011 IEEE International Symposium on IT in Medicine and Education, Guangzhou, China, 2011, pp. 531–535.

[15] R. H. Bamberger, “A prototype distance learning laboratory for image processing education,” in Technology-Based Re-Engineering Engineering Education Proceedings of Frontiers in Education FIE ’96 26th Annual Conference, Salt Lake City, UT, USA, 1996, vol. 1, pp. 51–54.