<table>
<thead>
<tr>
<th>Title</th>
<th>URL</th>
<th>Creative Commons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation of M-OER initiative (mobile OER): prospect and challenges</td>
<td><a href="http://weko.wou.edu.my/?action=repository_uri&amp;item_id=474">http://weko.wou.edu.my/?action=repository_uri&amp;item_id=474</a></td>
<td><a href="http://creativecommons.org/licenses/by-nc-sa/3.0/deed.ja">http://creativecommons.org/licenses/by-nc-sa/3.0/deed.ja</a></td>
</tr>
</tbody>
</table>
Implementation of M-OER Initiative (Mobile OER): Prospect and Challenges

Ean Teng Khor
School of Science and Technology,
Wawasan Open University, Penang, Malaysia
etkhor@wou.edu.my

Emerging Trends in Open and Distance Learning

This paper explores the challenges in developing the prototypes for the implementation of Mobile Open Educational Resources (M-OER) initiative in providing content availability and flexibility across mobile learners and explains how the architecture addresses these challenges and assists in both design and testing process. In this paper, M-OER has been successfully tested on three mobile platforms namely Apple iOS, Android, and BlackBerryOS. One of the main aims in this approach is to test content and accessibility features for M-OER and provide wider access to more mobile platforms. This paper also reviews the M-OER implementation architecture which includes the framework of M-OER Content Management System (M-OERCMS) with in-context content authoring environment, allowing users to develop and customize M-OER module lesson pages to meet their individual needs with the inclusion of Creative Commons licensing. The M-OERCMS enables users to interact and use set of commands, predefined functions, schemas and protocols when building content modules and opened-licensed materials. This new M-OER architecture is targeted to find new ways for engagement of learners in related to the discovery and sharing for the wider use of M-OER learning modules (e.g. using camera and video for user-generated content). This paper also describes the findings and technical challenges for establishing open sharing and accessibility of M-OER learning content to address the “same content, multiple channels” issue. The proposed M-OER is designed to be used across multiple platforms using Mobile XML-XSLT for content reuse to move away from manual reproduction approach. On the basis of the content availability across multiple devices platforms, challenges issues from the perspective of different mobile platforms are also addressed to reflect the fundamental needs for effective mobile learning.

Keywords: Mobile learning, OER, Mobile XML-XSLT
1.0 Introduction
This paper presents the development of Mobile OER (M-OER) initiative in the transformation middleware Application Programming Interface (API) through mobile XML-XSLT Presentation Generator web service broadcasting OER content in various mobile platforms. As the world becomes increasingly connected, there is a need for OER providers to provide mobile directory access for publishing and sharing of appropriate educational resources according to different devices’ platforms for mobile learners and license their respective learning material accordingly. In the last years, there is no clear work was found synthesizing how OER repositories are adapting to the M-learning paradigm and how OER can be used and reused on mobile devices. As a mode for content creation and sharing, it is essential to provide mobile users with access to real-time relevant OER and the ability to act on that information at anytime, anywhere. Hilton, Wiley, Stein and Johnson (2010) defined that the four “R’s” is the key donor for increases of the openness of an OER by reuse, redistribute, revise and remix. We expand this notion so that mobile learners can both offer and consume OER resources through mobile XML-XSLT web services broadcasting in increasing the openness of the OER. The M-OER initiative is targeted to be integrated with OER repositories with the inclusion of mobile web services aiming to create, manage and share OER and provide wider access to learners by embracing new technology. The paper is organized as follows: Section 2 reviews the literature and identifies the requirements for M-OER design. Section 3 and 4 provides the architecture of mobile middleware transformation in M-OER mobile application layer. The implementation and the comparative studies on different platforms’ accessibilities are reported in Section 5 and 6, followed by conclusion and discussion for future research in Section 7.

2.0 Design Requirements for M-OER
The design concern of M-OER approach is target to improve more visibility and exposure amongst a community of mobile users through the shareable web service in different OER media types accordingly to the handheld devices API. In this study, we review the following design concerns from three perspectives: (i) generic mobile environment issues, (ii) M-learning context using OER and (iii) standard for content packaging and delivery.

(i) Generic mobile environment issues
The awareness of the constraints of the user interface (UI) in mobile computing environment is considered as an important context towards M-learning. Mobile devices suffer from small screens, restrictive input methods and limited battery life. Several
advanced techniques have been tested to improve effectiveness of mobile UI, e.g. visual
dynamic queries, new navigation widgets, zoomable user interfaces. Therefore, the UI for M-learning application must meet users’ needs without overloading them with unnecessary complexity, operating too slowly or consuming excessive power (David, 2007). According to Uther (2002), successful mobile applications tend to employ many rich media objects, yet they should not distract from the learner’s experience. One of the commonly stated characteristics of M-learning content is that it should be delivered in short ‘nuggets’ rather than large units of information, which can be supported by appropriate use of different media types. Therefore the mobile media types have to be chosen with care and should support content appropriately. In this study, the issue of different media types is taken into consideration as one of the criteria of evaluating M-OER and classified as one of the requirement for quality M-learning.

(ii) M-Learning context in OER
In this section, we review the contextual features that can be used to access OER repositories in M-learning design requirements. M-learning has been used as a pre and/or post activity to other types of learning, complementing the classroom experience. The terms “just in time learning” or “fast learning” have been used to refer to content provided for the users in M-learning. Some recent M-learning applications, e.g. MERLOT is an example of portal based repository adapting the search functionality depending on the type of mobile platform aimed to use the content. Siadaty (2008) proposes the m-LOCO framework for contextualized mobile content delivery making use of different repositories retrieving learning objects includes information about the content structure (e.g., audio, video, text) and educational content types (e.g., example, overview or tutorial) of the learning content.

(iii) Standard for content packaging and delivery
The design considerations for mobile content packaging and delivery in web services protocols in mobile presentation layer include:

- Determining the preferred media, Reusable Learning Objects (RLOs), data types, content sources to be sent via setter/getter methods
- Input/output parameters responses to HTTP GET and POST requests
- Documents/literal as mobile devices Encoding Style with Synchronized Multimedia Integration Language (SMIL)
- Mobile presentation user interface with clearly-defined API
• Integration of test-bed where a variety of collaborative providers demonstrate how OER is shared

3.0 Research Objectives
The research project aims at designing, developing and evaluating mobile generated OER modules and enhances the re-use and creation of OER for different mobile platforms. The specific objectives of the study are to:

1. Evaluate different media types of content repositories offer using mobile platforms.
2. Designing a mobile API middleware transformation to support mLearning.
3. Development of M-OER course module to support instructor’s teaching and student’s learning experiences.
4. Evaluate the M-OER user’s accessibility and make further improvements as required.

The benefits of M-OER middleware transformation can be seen via creating, connecting, suggesting, commenting and annotating ideas targeted and fully harness the knowledge with the integration of different level of users mainly, academic peers, instructors, facilitators and students to consider their implications for learning, teaching and research in this study. One of the key aspects of adopting open practices is the ability to encourage lateral thinking and new perspective and creativity defined by Conole (2012).

The approach provides new opportunities for sharing of M-OER resources in global scale by inclusion of more mobile learners at any degree of distance via OER Content Management System (OERCMS). The M-OER transformation for different platforms mainly Apple IOs, Android and Blackberry is described in Figure 1.

![Figure 1: M-OER transformation for different mobile platforms](image)
In this proposed technique, the transformation middleware API provides a medium for the learners to retrieve and access OER contents through three different platforms (Apple iOS, Android, BlackBerry) using hybrid and native applications wirelessly as comparative study to evaluate device capabilities, accessibilities and selection of participatory media preferences. The adoption of OER in various mobile platforms approach defines more involvement of different levels of learners, instructors and reviewers in the OER learning contents and practices via different platforms offering creation of content modules, lectures video recordings and educational resources.

4.0 Architecture of Mobile OER
Integration of M-OER portability from this approach allows the deployment of mobile web services in additional format XML-XSLT Presentation Generator segregates the required media, e.g. text, image, audio and video to appropriate size and dimension through XSLT transformation. The approach is target to increase potentials mobile users for viewing and streaming (podcasting) learning modules in different choice of participatory media. In addition, the developed presentation layer of OER interfaces for mobile devices are portable for all XML-XSLT web services published by collaborating repositories.

The OER repositories are able to integrate the published mobile middleware via XML-XSLT web services at their designated protocol and environment to be part of the OER Creation Team and shareable OER case studies, learning modules and portfolios.

Figure 2: Architecture of M-OER - Mobile Application Layer
The framework of the M-OER and integration of transformation platform (core backbone) is illustrated in Figure 2. The OER creation cycle in mobile application layer charted a step by step pathway including OERCMS (serve as personal workspace), CC selections, OER Module Creation, Post-Publication Layout View, Interface Layer (GUI) and different devices accessibilities.

The OER Module Creation is designed to package (i) standalone (ii) combined modules (merged with related modules to form larger work or collection). Authors are able to include related modules, mix in to customize to fit their own needs in module creation. A well-written module consists of images, audio and video files in assisting learners by aligning various participatory media to support the learning activity or goal. Finally, the layout view is designed as a post-publication review for users to identify or endorse participatory media in the content viewed in different devices.

5.0 Implementation

In Figure 3, the OERCMS interface that deployed in ASP.NET 4.5 and using a centralized MS SQL Server 2012 environment provides the development of OER content takes place via automated, real-time access of changes and modification in multi-level OER actors.
The OERCMS serves as an authoring tool for the creation of OER and managing the evaluation task (review/keep track) of Quality Assurance (QA) practices. The OER core team is required to coordinate support in ensuring OER materials can be reuse and repurpose by interested parties with the selection of appropriate Creative Commons (CC) license for end user that can be readily shared and published in mobile platforms. According to Fitzgerald (2007) the Open Content Licensing (OCL) protects the expression of an idea for having the work widely disseminates and to promote better identification and reutilization of the content.

The inclusion of teaching and learning point of view by the assessor as the requirement for the systematic evaluation during Creation Phase in engaging the improvement of teaching materials particularly in design practice that enables the instructors to make informed choices on the use of different media presentations. The knowledge (prior learning and prior experience) build from the learners and teaching experience from the instructors is therefore created a learner-oriented learning content with different participatory media.

6.0 Results and Findings
The definition of web service and encoding style were defined by the collaborative institutions to be implemented on desirable mobile interface. Queries sent by mobile clients will be processed in web services messaging techniques to return appropriate request to the targeted interface. As depicted in Figure 4 and Figure 5, M-OER sharing approach prototype is accessible via the following published protocols (i) Basic Electronics and (ii) Java Fundamentals as the pilot study courses:

**Mobile XML (M-XML)**

```xml
<oerrepository1>
  <oercontent name="Basic Electronics">
    <image file="BasicElectronic1.jpg"/>
    <Lesson name="Lesson1">
      <lesson content="Introduction">
        <learningobj>Electric Circuits</learningobj>
        <learningobj>Linear Algebra</learningobj>
      </lesson>
      <Lesson name="Lesson2">
        <lesson content="Introduction">
          <learningobj>Analog Integrated Circuits</learningobj>
          <imagepath>images/Figure1.jpg</imagepath>
        </lesson>
      </Lesson>
    </oercontent>
  <audio file="BasicIntro.avi"/>
</oerrepository1>
```

**Figure 4: Case study: M-XML and M-XSLT created for Basic Electronic Module 1:**
Figure 5: Case study: M-XSLT created for Basic Electronic Module 2:

Figure 6 presents the outcome of the analysis performed on the M-OER learners that was collected from the study. The study was conducted based on 74 learners at the end of the content delivery period in the two pilot study courses. As observed from Figure 6, majority of the learners (77%) agree that repositories search, interactive multimedia support, content ranking, location based services, help documentation and cloud storage are essential functionalities in M-OER. Only less than 30% do not consider providing the functionalities is useful in M-OER. Interactive multimedia supports are found to be highly voted as learner can perform study with rich interactive learning course that nicely match their own learning style and their access devices.

Figure 6: Responses of participants towards M-OER functionalities
The survey findings in Figure 7 shows that “Rich Media” and “Audio-based” media are the most preferred media type in the case studies conducted. The learners learned the basics on a topic, short videos from experts that provide more advanced applications of a concept or added depth from stories based on real world experience. The asynchronous animated, audio and video learning resources can be downloaded or streamed to a mobile device in real time.

- **Text-based**
  Instructor-designed learning materials that in the form of slides

- **Audio-based**
  Utilize discussion articles in an audio file format

- **Rich Media**
  Utilize graphics, video, and audio clips
### Table 1: Analysis of the M-OER accessibility with different Media Types

<table>
<thead>
<tr>
<th>Created Modules</th>
<th>Targeted Platforms</th>
<th>Media Types</th>
<th>Scale and factors for measures of constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Navigation</td>
</tr>
<tr>
<td>Basic Electronics (OER Resource 1)</td>
<td>Apple iOS Mobile</td>
<td>Text-based</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audio-based</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rich Media</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td>BlackBerryOS Mobile</td>
<td>Text-based</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audio-based</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rich Media</td>
<td>8.9</td>
</tr>
<tr>
<td></td>
<td>Android Mobile</td>
<td>Text-based</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audio-based</td>
<td>8.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rich Media</td>
<td>8.5</td>
</tr>
<tr>
<td>Java Fundamentals (OER Resource 2)</td>
<td>Apple iOS Mobile</td>
<td>Text-based</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audio-based</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rich Media</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>BlackBerryOS Mobile</td>
<td>Text-based</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audio-based</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rich Media</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>Android Mobile</td>
<td>Text-based</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audio-based</td>
<td>9.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rich Media</td>
<td>8.7</td>
</tr>
</tbody>
</table>

*The users are required to choose a scale of (0-10) for each factor measurements #Navigation

- Ease of use, interaction with the M-OER is clear and understandable
- Easy to view, select, replay via the M-OER lesson pages
- Easy to remember the flow of learning tasks using the M-OER #Perceived Usefulness
- Use of the M-OER improves my knowledge and performance
- Use of the M-OER improves and enhance my knowledge on the subject area
- Use of the M-OER enhance my effectiveness as regards to my working environment #Concentration
- Ability to absorb intensely in the content and activity
- My attention was focused on the learning activity

### CC Implementation

The CC implementation covers the following license conditions: (BY), (BY-NC), (BY-SA), (BY-NC-SA), (BY-ND), (BY-NC-ND), etc. The assurance is made aware throughout the learners associated with the OER content and encouraging the unlocking of knowledge to the global society. The OERCMS requires that all content created in the OER repository be placed under an OCL (Fitzgerald, 2007) that allows others to use, distribute or create derivative works based upon the content as depicted in Figure 8. Author’s guidelines, peer review instructions, reviewer’s role and external assessor’s guidelines were incorporated into this approach in the OERCMS.
7.0 Conclusion

This paper described how M-OER resources sharing via middleware transformation is implemented in different platforms accessibilities particularly in mobile presentation layers and application layer. M-OER is a new trend of E-Learning which will be essential to OER organization and raising the awareness of the benefits of sharing rich text audio, video and visual materials to provide cumulative benefit for both learners and educators. The open sharing approach in M-OER is targeted to engage newcomers and learning communities for resource sharing and platform testing in different mobile devices. One of the key features of the architecture is the use of mobile XML and XSL Transformation (XSLT) web services to transfer structured data information, modules running on different platforms with selected media presentation and provides interoperability between mobile devices. It provides an intelligent solution and a shared model of technology-enhanced middleware transformation (including protocols for publishing web services) to be effectively shared to wider audiences.

This approach is therefore establishes the awareness of sharable learning contents and experiences via different mobile clients in focusing the online learning communities and practitioners. The implementation of sharing via mobile middleware API encourages the educators in sharing more learning materials under the mobile XML-XSLT concept in different participatory media and platforms among collaborative institutions.

6.0 Future Work

The M-OER approach is targeted to demonstrate benefits to learners by enabling more mobile learners to access more OER resources and provide a common ground in M-OER creation lifecycle for producing and reusing educational resources in the creation and accessibility phase. Institutional OER repositories can be the key drivers for the integrated mobile sharing development in coming years to support more personalized
M-OER learning paths and promoting OER via openness and visibility approach to increase the reach of opportunity.

References:


