Creation, Repurpose and Sharing of Mobile OER Initiative via Middleware Transformation API – New approach to Openness and Visibility

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Technology-enhanced teaching and learning

The main objective for the approach is to provide data transformation and broadcasting of Mobile OER (M-OER) contents particularly via mobile middleware Application Programming Interface (API) in various institutions and learning communities. We expand this notion so that handheld devices mainly mobile, tablet PCs learners can both offer and consume OER learning contents through the process of optimization for the delivery of educational resources in different mobile platforms (Apple IOs, Android, BlackBerry, Windows Mobile, etc). This approach signifies the OER usage and the creation of different presentation formats according to the compatible handheld devices and represents the corresponding learning accessibility and navigation for use in multiple mobile platforms. The initiative provides a framework for the implementation of the publishing API for the learners to retrieve OER content streamlined through mobile XML-XSLT backbone in mobile learning environment – to match device capabilities, accessibilities and selection of participatory media preferences. One of the main aims in this approach is to test content and accessibility features in offering access and increasing visibility to the authors and learners of the OER content for the improvement of creating, populating, tagging and re-use of media, navigations in the recommended platform. The mobile API enables users to interact and use set of commands, predefined functions, schemas and protocols when building content modules and opened-licensed materials for the OER resources. The OER Content Management System (OERCMS) with mobile sharing test-bed supports the transformation of educational resources and activities, allowing entities to develop and customize M-OER module lesson page to meet their individual needs with the inclusion of Creative Commons (CC) licensing. This new educational ecosystem via mobile middleware transformation API is targeted to find new ways for engagement of learners in the vision of openness and contributing to wider use of OER learning modules that is significant strategic value towards the institutions and organizations as an alternative channels to shift towards more OER mobile user interfaces.

1.0 Introduction

This paper presents the creation, assurance, repurpose and sharing of Mobile OER (M-OER) initiative in the transformation middleware Application Programming Interface (API) for various institutions, learners, educators, facilitators, learning community particularly in the promotion of openness and visibility through mobile XML-XSLT Presentation Generator web service broadcasting and data transformation in various mobile platforms.

As the world becomes increasingly connected, there is a need for OER providers to provide directory access for publishing and sharing of different platforms according to different devices for individual learners and license their respective learning material accordingly. 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 and tablet PCs learners can both offer and consume OER resources through mobile XML-XSLT web services broadcasting in increasing the visibility and openness of the OER. The M-OER initiative is targeted to be integrated with interested OER resources providers (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 "Visibility" approach signifies the OER usage and the creation of awareness towards OER to improve more visibility and exposure amongst a community of users through the shareable web service in different presentation formats accordingly to the handheld devices API and represent the corresponding learning accessibility in the targeted mobile learning environment.

The adoption of OER in various platforms to increase the openness in OER is illustrated in Figure 1. The openness 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. Openness approach provides new opportunities for construction of OER resources in global scale by inclusion of more audiences and enthusiastic colleagues at any degree of distance and widest possible coverage of educators and learners via OER Content Management System (OERCMS).
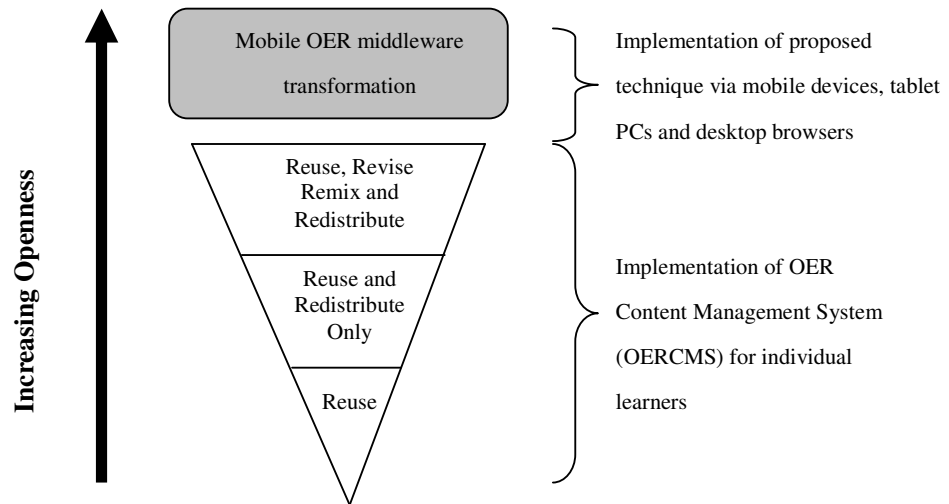
Figure 1: Mobile OER Transformation Integration with Four R's focusing in Increasing Openness of OER

In this proposed technique, the transformation middleware API provides a medium for the learners to retrieve and access OER contents through different platforms (Apple IOs, Android, RIM BlackBerry, Windows Mobile, etc) using hybrid and native applications wirelessly as comparative study to evaluate device capabilities, accessibilities and selection of participatory media preferences. The focus of this research is to evaluate the creation and sharing of M-OER contents in developing new countermeasures for transformations in different device platforms' accessibilities. The remaining of this paper is organized as follows: Section 2 introduces the architecture of M-OER. Section 3 provides the integration and framework of mobile middleware transformation in presentation layer and interface layer. The implementation and the comparative studies on different platforms' accessibilities are reported in Section 4, followed by conclusion and discussion for future research in Section 5.

2.0 Architecture of Mobile OER – vision of Openness

The openness concept adopted in M-OER transformation for different platforms mainly mobile devices, tablet PCs and web applications is described in Figure 2. The benefits of sharing good practices in M-OER middleware transformation can be seen via creating, connecting, suggesting, commenting and annotating ideas targeted for different platforms and fully harness the knowledge with the integration of different level of users mainly, coordinators, academic peers, instructors, tutors, 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).
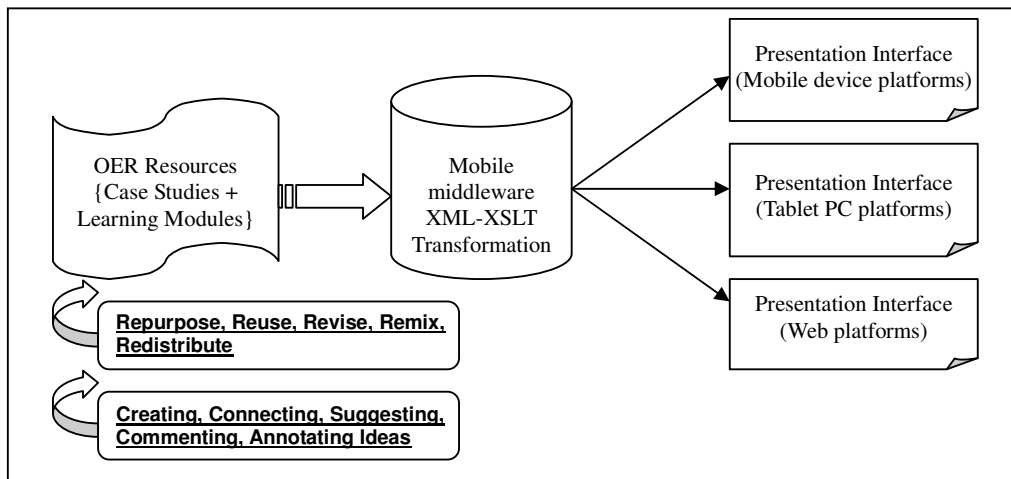
Figure 2: Mobile XML-XSLT transformation for individual User Interface (UI) presentation

3.0 Visibility and Sharing via mobile middleware API to support mobile client interoperability

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.

Integration of M-OER portability from this approach allows the deployment of mobile web services in additional format such as mobile or handheld devices, tablets, desktop computers (Web Application). 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 opened 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, tablet PCs are portable for all XML-XSLT web services published by collaborating repositories.

The associated OER institutions and interested audiences 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.
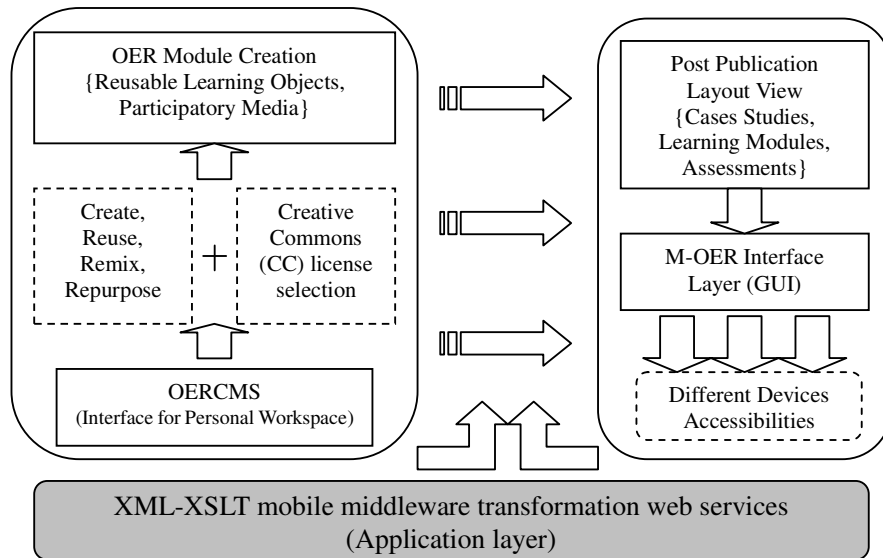
Figure 3: Framework of M-OER in transforming wider accessibility
(Mobile Application Layer)

The framework of the OER creation and integration of transformation platform (core backbone) is illustrated in Figure 3. 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, M-OER Interface Layer - GUI and different devices accessibilities. The OER Module Creation is designed to cater/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. An example of mobile XML (Basic Electronics: Lesson1, Lesson 2) with XSLT (text, image and audio) is depicted below:

| Mobile XML (Basic Electronics example)	Mobile XSLT (Template for text, image, audio example)

`<oerrepository1>`
`<oercontent name="Basic Electronics">`
`<image file="BasicElectronic1.jpg"/>`
`<Lesson name="Lesson1">`   _Text "Electric Circuits"_
`<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>`   _Image file "Figure1.jpg"_
`</oercontent>`
`<audio file="BasicIntro.avi"/>`
`</oerrepository1>`   _Audio file "BasicIntro.avi"_
	`<xsl:stylesheet xmlns:xsl="http://www.w3.org/TR/WD-xsl">`
	`<xsl:template match="/">`
	`<html>`
	`<body>`
	`<div id="content">`
	`<xsl:apply-templates select="oerrepository1" />` _<Content Template> "oerrepository1" Style attributes_
	`</div>`
	`</body>`
	`</html>`
	`</xsl:template>`
	
	`<xsl:template match=" Lesson1">` _<Specify Template> The description governed by the "Lesson1" Style attributes_
	`</xsl:template>`
	
	`<xsl:template match="Lesson2">` _<Specify Template> The description governed by the "Lesson2" Style attributes_
	`</xsl:template>`
	`</xsl:stylesheet>`

4.0 Implementation
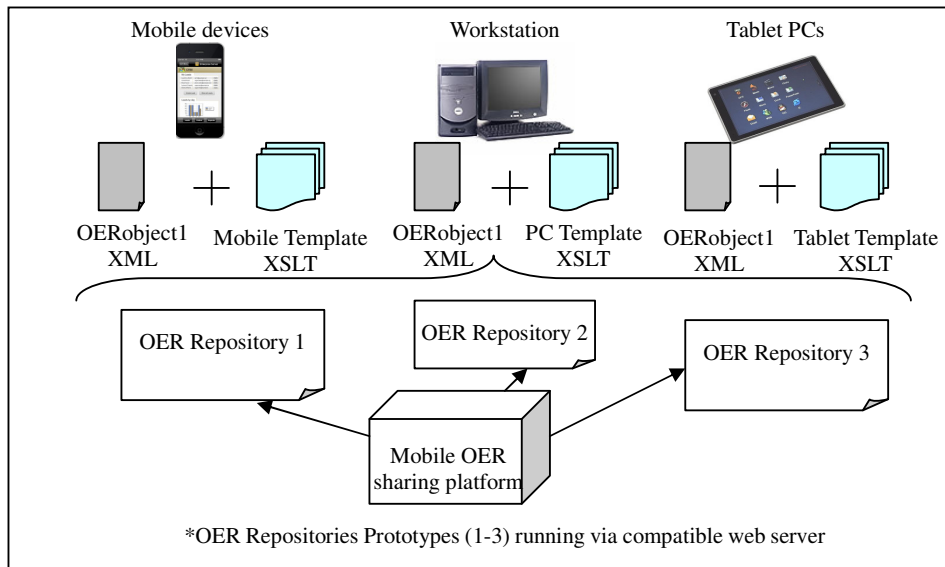
Figure 4: Mobile OER web services for different repositories and portability interfaces

The definition of web service and encoding style were defined by the collaborative institutions to be implemented on desirable mobile/tablets/web 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, M-OER sharing approach prototype is accessible via the following published protocols (Basic Electronics as the pilot study lesson):

http://oersharing.tk/lessons/BasicElectronics.xml The sharing of mobile XML web services indicates the participatory media data (XML format) used for lessons.

http://oersharing.tk/lessons/BasicElectronics.xslt The sharing of mobile XSLT web services determines the layout and Graphical User Interface (GUI) placement of text, image, audios and videos.

Mobile OER Sharing Prototype	Platforms	Mobile XML-XSLT Web Services (examples)
http://oersharing.tk (Main OER CMS)	ASP.NET, SQL Server 2012 (PC Browser)	http://oersharing.tk/lessons/BasicElectronics.xml http://oersharing.tk/lessons/BasicElectronics.xslt
http://oersharing.tk/lessons/iphone/	Apple IOs	http://oersharing.tk/lessons/iphone/BasicElectronics.xml http://oersharing.tk/lessons/iphone/BasicElectronics.xslt
http://oersharing.tk/lessons/ipad/	Apple IOs	http://oersharing.tk/lessons/ipad/BasicElectronics.xml http://oersharing.tk/lessons/ipad/BasicElectronics.xslt
http://oersharing.tk/lessons/bberry/	BlackBerry	http://oersharing.tk/lessons/bberry/BasicElectronics.xml http://oersharing.tk/lessons/bberry/BasicElectronics.xslt
http://oersharing.tk/lessons/android/	Android	http://oersharing.tk/lessons/android/BasicElectronics.xml http://oersharing.tk/lessons/android/BasicElectronics.xslt
http://oersharing.tk/lessons/winmobile/	Windows Mobile	http://oersharing.tk/lessons/winmobile/BasicElectronics.xml http://oersharing.tk/lessons/winmobile/BasicElectronics.xslt

4.1 Protocols published through collaborating web service networks

Design considerations for mobile XML-XSLT web services protocols in mobile presentation layer are shown in Figure 5:

- 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 (UI) with clearly-defined API
- Integration of test-bed where a variety of collaborative providers demonstrate how OER is shared
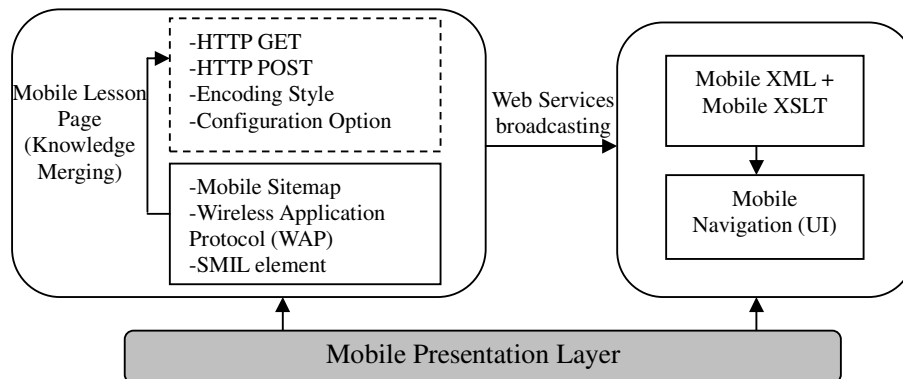

Figure 5: Framework of M-OER (Mobile Presentation layer)

- **Mobile XML**

The goal for development using the mobile Extensible Markup Language (XML) is to deliver structured, complex content over data publications channels. The design of mobile XML has the flexibility of Standard Generalized Markup Language (SGML) (Khan & Ali, 2009) and the simplicity of HTML. Mobile XML is primarily a meta-language for describing mobile markup languages and allows users to define their own set of tags and the structural relationships between the tags with association of Document Type Definition (DTD) (Wei, Ni & Jia, 2010) in the document.

- **Mobile XSLT**

The mobile Extensible Stylesheet Language Transformation (XSLT) is the style language used to describe how the elements XML are presented in predefined semantics manner in respective mobile devices. XSLT specification (Ishikawa et al., 2006) is divided into two sections namely: "Vocabulary of formatting objects (XSL-FOs) that have the necessary base semantics" and "Language for transforming the original XML document to the document that is composed of the elements having formatting semantics".

4.2 Implementation of M-OER contents sharing – Creation and Accessibility Phase
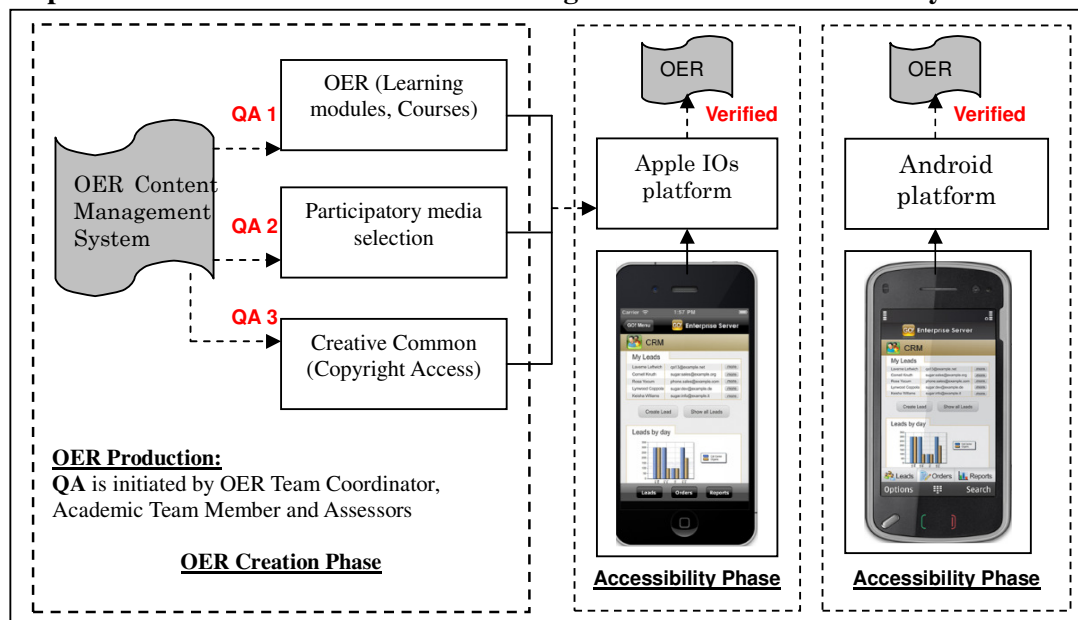

Figure 6: Creation and Accessibility of Mobile OER Contents

- **OER Content Management System**

In Figure 6, the OERCMS interface that deployed in ASPNET 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 via QA1-QA3 (Figure 6: 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 evaluated in Table 1.

Table 1: Analysis of the Mobile OER accessibility with different platforms and participatory media

Created Modules	Targeted Platforms	Participatory Media	Scale and factors for measures of constructs		
			Navigation	Perceived Usefulness	Concentration
Basic Electronics (OER Resource 1)	Apple IOs Mobile	Text, Graphics	7.5	6.8	7.9
	Apple IOs Tablet	Text, Graphics, Audio	8.1	8.8	8.9
	BlackBerry OS Mobile	Text, Graphics	6.5	6.1	7.1
	BlackBerry Playbook	Text, Graphics, Audio	8.5	8.9	8.2
	Android Mobile	Text, Graphics	7.2	7.1	7.5
	Android Tablet	Text, Graphics, Audio	8.4	8.2	8.8
	Windows Mobile	Text, Graphics	7.1	6.2	7.0
Java Fundamentals (OER Resource 2)	Apple IOs Mobile	Text, Graphics	7.8	7.1	7.2
	Apple IOs Tablet	Text, Graphics, Video	9.1	9.5	9.8
	BlackBerry OS Mobile	Text, Graphics	7.3	7.2	6.9
	BlackBerry Playbook	Text, Graphics, Video	9.0	9.1	9.2
	Android Mobile	Text, Graphics	6.8	6.7	6.9
	Android Tablet	Text, Graphics, Video	9.1	9.4	9.5
	Windows Mobile	Text, Graphics	6.3	7.1	6.8

Tablets devices accessibility achieved highest average scale of measurements

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

#Navigation
- Ease of use, interaction with the Mobile OER is clear and understandable
- Easy to view, select, replay via the Mobile OER lesson pages
- Easy to remember the flow of learning tasks using the Mobile OER

#Perceived Usefulness
- Use of the Mobile OER improves my knowledge and performance
- Use of the Mobile OER improves and enhance my knowledge on the subject area
- Use of the Mobile 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 7. Author's guidelines, peer review instructions, reviewer's role and external assessor's guidelines were incorporated into this approach in the OERCMS.
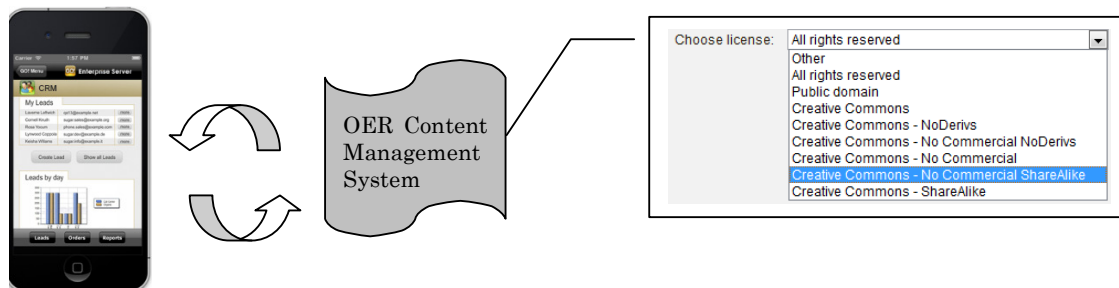

Figure 7: Creative Commons License selections

5.0 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 individual devices mainly mobile devices, tablets and web application browsers. 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.

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.

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