

The 9<sup>th</sup> International Scientific Conference  
eLearning and software for Education  
Bucharest, April 25-26, 2013  
10.12753/2066-026X-13-070

**EVALUATION AND COMPARISON OF EIGHT OPEN COURSEWARE BASED ON  
A QUALITY MODEL**

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***Abstract:** Currently, in spite of the scale, popularity, and influence of the growing movement of open educational resources and open courseware on users worldwide, there is yet no quality evaluation framework that could provide support for learners, instructors, faculty, developers, evaluators etc. We present here both an evaluation and a comparison between eight open courseware on databases, which are offered by different open courseware providers, and that comply with different open courseware paradigms. Both evaluation and comparison are based on our set of quality criteria that serve as general guidelines for development, use, modification, evaluation, and comparison of open educational resources and open courseware, from a social and constructivist perspective.*

***Keywords:** open courseware, open educational resources, quality criteria, quality assessment*

## **I. INTRODUCTION**

In our time, there is a massive need for finding new ways of educating people and communities worldwide, given the demographic trends and the emerging universal aspiration for improving one's education, during a lifelong process of personal evolution within the knowledge and information society. The open educational resources and open courseware projects around the world have appeared in the larger context of open systems, building up on the premise that new enhanced paradigms of education will emerge, in a similar way with what happened when the open source paradigm has become a key enabler of the creativity of software developers, with amazing results that will influence positively the life of people having access to them.

For the time being, in spite of the scale, popularity, and influence of the growing movement of open sharing of educational resources and courseware on users around the world, there is yet no quality evaluation framework that could provide support for (1) learners and instructors in their quest for reaching the most appropriate educational resources for their specific educational needs in any particular context, neither for (2) faculty or institutions that are or want to become involved in this movement, and they may be concerned about the challenges or interested in the gains of this process, nor for (3) developers who need guidelines for designing and building such educational resources, nor for (4) educational resources' evaluators [1, 2, 3, 4]. However, more and more interest is focused on the construction of proper solutions for quality assessment of Open Educational Resources (OERs) and OpenCourseWare (OCW), even though, for now these solutions are very thin and at the very beginning of their life cycle.

Our work here subscribes to this interest, and builds up on our work on constructing a quality model for OERs and OCW. Thus, in this paper, we evaluate and compare quality-wise eight open courseware on databases offered by different major open courseware providers that comply with different open courseware paradigms. This comparison is guided by our set of socio-constructivist quality criteria, which has been introduced in our previous works [1, 2, 3], and that serve as general guidelines for development, use, modification, evaluation, and comparison of open courseware and

OERs. Moreover, we work here those quality criteria on the chosen open courseware, aiming to learn, how to develop further the initial set of quality criteria towards a proper quality model.

After searching thoroughly various prestigious scholar repositories, we have found just a few related works that will be overviewed briefly further on. In [5] an instrument for reviewing learning objects (called LORI) is introduced, which incorporates several quality facets regarding content quality, learning goal alignment, feedback and adaptation, learners' motivation, presentation design, interaction usability, accessibility, reusability, and standards compliance. This instrument may be used within a suite of tools for collaborative evaluation that small evaluation teams can use to produce an *aggregated view of ratings and comments*. In [6] seven rubrics are offered, five being adapted from LORI (content quality, motivation, presentation design, usability, accessibility), while two other are new: educational value (enables learning, accuracy, clarity, and unbiasedness) and overall rating (perceived usefulness of each resource in an educational context). Achieve has developed eight quality rubrics, and, recently, it has teamed up with OER Commons to develop an online evaluation tool that use those rubrics, and that allows storage of the resulted assessment data [7,8]. Achieve rubric includes the degree of alignment to standards, the quality of explanation of the subject matter, utility of instructional materials, quality of assessment, quality of technological interactivity, quality of instructional and practice exercises, opportunities for deeper learning, and assurance of accessibility.

The structure of the paper is as follows: the second section reviews the quality model, the fourth introduces the eight "candidates" to be evaluated and compared within the Section 5, which includes also some discussions, and the last one includes some conclusions and future work ideas.

## II. THE QUALITY MODEL

In this section we present briefly the quality criteria for quality assurance of open educational resources and open courseware, which have been introduced and presented in much more detail in [1], and put to work in [2] and [3], and refined further elsewhere [4]. These criteria can be applied for assessing quality of both small learning units and entire courseware. They fall within four categories concerned with the quality of the content, of the instructional design, of the technology-related aspects, and with the assessment of the courseware, as a whole. These criteria correspond to the quality characteristics of quality in use, internal and external product quality according to ISO/IEC 25000 SQuaRE standard, and they cover the next user needs: effectiveness, efficiency, satisfaction, reliability, security, context coverage, learnability, and accessibility [1, 2, 3, 4]. A very concise presentation of these quality criteria is included in Table 1, which works as a rubric for the quality model. For the time being the evaluation is subjective, being based on more than 20 years of author's experience in Higher Education, particularly here, in teaching databases. However, as presented in the related work, this seems to be the tendency of other works in this area.

**Table 1.** Criteria for Quality Assurance of OCW and OER

<i>Content related</i>	<i>To what degree an OER/OCW allows learners to have <b>engaging learning experiences</b> that provide for <b>mastery of the content</b>.</i>	
	• CR1: readability	0-5
	• CR2: uniformity of language, terminology, and notations	0-5
	• CR3: availability of the course syllabus	0-5
	• CR4: comprehensiveness of the lecture notes	0-5
	• CR5: modularity of the course content	0-5
	• CR6: possibility to select the most suitable learning unit	0-5
	• CR7: opportunity to choose the most appropriate learning path	0-5
	• CR8: top-down, bottom-up or combined approach	0-5
	• CR9: availability of assignments (with or without solutions)	0-5
• CR10: <i>resource related</i> : accuracy <sup>1</sup> , reasonableness <sup>2</sup> , self-containedness <sup>3</sup> , context <sup>4</sup> , relevance <sup>5</sup> , multimedia inserts <sup>6</sup> , interactive elements <sup>7</sup> , correlation with the entire course <sup>8</sup> , links to related readings <sup>9</sup> , links to other resources (audio, video etc.) <sup>10</sup>	0-5 x10	

<b>Instructional design</b>	<i>Criteria that address the <b>instructional design</b>, and other <b>pedagogical aspects</b> of T&amp;L.</i>	
	<ul style="list-style-type: none"> <li>• ID1: goal and learning objectives (<u>outline</u> the material)</li> <li>• ID2: learning outcomes (students will know/be able to do – <u>skills, abilities, attitudes</u>)</li> <li>• ID3: appropriate instructional activities</li> <li>• ID4: evaluation and auto-evaluation means (with sol.)</li> <li>• ID5: learning theory</li> <li>• ID6: instructional design model</li> <li>• ID7: <i>reflective learning opportunities</i> in which the outcome of education becomes the construction of coherent functional knowledge structures adaptable to further lifelong learning</li> </ul>	0-5 (1 global + 4 per unit) 0-5 (1 global + 4 per unit) 0-5 0-5 (ex./others(1+1.5) x2) 0-5 0-5 0-5
<b>Technology related</b>	<i>Both OERs and O CW are expected to <b>benefit fully from ICT technologies</b>, and to comply with various standards.</i>	
	<ul style="list-style-type: none"> <li>• TR1: conformity with standards for interoperability</li> <li>• TR2: compliance with standards for accessibility</li> <li>• TR3: <i>extensibility</i>: easiness of adding content, activities and assessments, from a technological point of view (both developers and learners)</li> <li>• TR4: user interface’s basic technological aspects (hardware-device, software, networking)</li> <li>• TR5: supporting technology requirements at user’s end</li> <li>• TR6: prerequisite skills to use the supporting technology</li> <li>• TR7: multi-platform capability</li> <li>• TR8: supporting tools</li> </ul>	0-5 0-5 0-5 (2.5+2.5) 0-5 0-5 0-5 0-5 0-5
<b>Courseware evaluation</b>	<i>All major open courseware initiatives have recently become more <b>involved with their learners</b>. Hence, regular assessment of <b>effectiveness of open courseware</b> becomes essential, along with using the results for further improvements.</i>	
	<ul style="list-style-type: none"> <li>• CW1: <i>courseware overview</i>: content scope<sup>1</sup> and sequence<sup>2</sup>, intended audience<sup>3</sup>, grade level<sup>4</sup>, periodicity<sup>5</sup> of content updating, author’s credentials<sup>6</sup>, source credibility<sup>7</sup>, multiple-languages<sup>8</sup>, instructor facilitation<sup>9</sup> or semi-automated support<sup>10</sup>, suitability for self-study<sup>11</sup>, classroom-based<sup>12</sup> study, and/or peer collaborative<sup>13</sup> study, time requirements<sup>14</sup>, grading policy<sup>15</sup>, instructions on using<sup>16</sup> the courseware, reliability<sup>17</sup>, links to other<sup>18</sup> educational resources (readings, OCW, OERs etc.)</li> <li>• CW2: availability of prerequisite knowledge</li> <li>• CW3: availability of required competencies</li> <li>• CW4: matching the course schedule with learner’s own pace</li> <li>• CW5: <i>terms of use (service)</i>: availability of repository or institutional policies wrt copyright and licensing issues, security for primary, secondary and indirect users, anonymity, updating and deleting personally identifiable information, age restrictions, netiquette, etc.</li> <li>• CW6: freeness of bias and advertising</li> <li>• CW7: suitable design and presentation of educational content</li> <li>• CW8: <i>user interface richness (style)</i>: navigational consistency<sup>1</sup>, friendliness<sup>2</sup>, multimedia<sup>3</sup>, interactivity<sup>4</sup>, adaptability<sup>5</sup> (both to user’s needs and context) etc.</li> <li>• CW9: providing a formal degree or a certificate of completion</li> <li>• CW10: <i>participatory culture and Web 2.0 facets</i>: contribution to the content<sup>1</sup>, collection of users’ feedback<sup>2</sup>, collaboration with fellows<sup>3</sup>, sharing the development<sup>4</sup>/using<sup>5</sup> experience</li> </ul>	0-5 x18  0-5 0-5 0-5 0-5  0-5 0-5 0-5x5  0-5 0-5x5

### III. THE CANDIDATES

When we started to look for candidates for our evaluation and comparison, given the momentum of the OERs and OCW movement, we thought that there will be plenty of open instructional resources on databases. The reality has not been quite so, and we have ended up with just a few open courseware and/or open educational resources that cover the necessary content for an introductory course on databases. To reach those resources we have been searching in several OER/OCW repositories, such as: MIT OpenCourseWare, OCW Consortium, The Saylor Foundation, University of Washington Computer Science and Engineering courses, Coursera, OER (Open Educational Resources) Commons, Webcast.Berkeley, Connexions, Universia OCW, ParisTech, Open.Michigan, Edx universities, University of California, Irvine, University of Southern Queensland, Utah State University, Intute, Textbook search, and a great deal of other. We have been using either the repository's specific search capabilities, or "classic" Google searches. Furthermore, we also have benefited from both Google's custom OER/OCW search and OCW Search. The sought after "nominees" have been comprehensive open courseware and/or open educational resources on database fundamentals (being it OpenCourseWare, namely developed based on MIT OCW paradigm, or any other mix of open courseware and/or open educational resources).

In the end, despite our best efforts, we remained with just eight workable candidates, because, for example, some OERs were available only in some foreign languages we could not understand, or others consisted only in video recordings of actual teaching of the course content in the classroom, and it would have not been fair to compare it with others, more heterogeneous blends of instructional materials. These finalists (see Table 2) are available in various open courseware repositories that comply with different open courseware paradigms, and they are as follows (each one of them has been assigned an acronym to ease further presentation and discussions):

**Table 2.** The candidates for evaluation and comparison: OCW and OER on databases

Source	Name	Acronym
MIT OpenCourseWare	<i>Database Systems</i>	1-MIT-DB
Saylor Foundation	<i>Introduction to Modern Database Systems</i>	2-Saylor-DB
Stanford/Coursera, Jennifer Widom	<i>Introduction to Databases</i>	3-St-WidDB
Connexions, Nguyen Kim Anh	<i>Introduction to Database Systems courseware</i>	4-Cnx-NKA
KFUPM OpenCourseWare	<i>Database Systems</i>	5-KF-DBS
University of Washington	<i>Introduction to Data Management</i>	6-UW-DMg
Universidad Charlos III de Madrid	<i>Database Fundamentals (Fundamentos de las bases de datos)</i>	7-UC3M
Universidad Politecnica de Madrid	<i>Database Administration (Administracion de bases de datos)</i>	8-UPM-DB

### IV. THE EVALUATION AND COMPARISON

We have scored the nominees based on the criteria presented in Section 2. As we said previously, the scores have been given based on our subjective judgment, which relies on 20+ years in teaching Databases in Higher Education. When scoring, we have proceeded from the point of view of teachers focusing on learners' needs, i.e. how useful the resources can be for novice learners who use them as open courseware or open educational resources. We have also kept in mind to assess the true potential of the evaluated resources to act as beneficial supporting educational resources for independent learners, who study that particular subject, under the OCW/OER paradigm. In the Table 2, one finds the scores for each courseware against the criteria, each criterion being evaluated on a scale from 0 to 5. The data in the table are to be read as follows: the odd lines include the scores for each and every criterion, in the corresponding category, while the even ones present the totals per category, and also the grand total per candidate.

**Table 3.** The evaluation and comparison matrix

OCW	CR1-10	ID1-7	TR1-8	CW1 (1-18)	CW 2-10
1-MIT-DB T <sub>1</sub> =197	2.5, 2.5, 5, 4, 5, 3, 3, 5, 2, 5, 5, 5, 5, 5, 0, 0, 5, 5, 0	1, 1, 3, 2.5, 0, 0, 0	5, 5, 2.5, 2, 5, 5, 5, 5	4, 4, 5, 5, 0, 5, 5, 0, 0, 0, 5, 5, 0, 0, 2, 4, 5, 1	5, 5, 5, 5, 5, 2, 5, 2, 0, 0, 2, 0, 0, 2, 0, 0, 0
	T <sub>CR</sub> =67	T <sub>ID</sub> =7.50	T <sub>TR</sub> =34.50	T <sub>CW</sub> =88	
2-Saylor-DB T <sub>2</sub> =290	2.5, 2.5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 1, 5	5, 5, 5, 5, 0, 0, 5	5, 5, 2.5, 3, 5, 5, 5, 5	5, 5, 4, 4, 0, 2.5, 5, 0, 0, 2, 5, 5, 5, 5, 5, 5, 5, 5	5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 2, 5, 3, 3, 3
	T <sub>CR</sub> =86	T <sub>ID</sub> =25	T <sub>TR</sub> =35.50	T <sub>CW</sub> =143.50	
3-St-WidDB T <sub>3</sub> =250	5, 5, 3, 3, 5, 5, 5, 5, 2, 5, 5, 5, 5, 5, 5, 0, 5, 1, 5	0.5, 0, 5, 5, 0, 0, 5	5, 5, 2.5, 2, 5, 5, 5, 5	4, 4, 0, 0, 0, 5, 5, 0, 2, 2, 5, 5, 5, 0, 5, 5, 5, 1	5, 5, 5, 5, 5, 5, 5, 4, 3, 1, 2, 5, 0, 5, 3, 5, 5
	T <sub>CR</sub> =79	T <sub>ID</sub> =15.50	T <sub>TR</sub> =34.50	T <sub>CW</sub> =121	
4-Cnx-NKA T <sub>4</sub> =180.75	5, 5, 5, 5, 5, 1, 1, 3, 2, 5, 5, 5, 5, 5, 0, 0, 5, 1, 0	2.5, 1, 3, 1, 0, 0, 0	5, 5, 4, 5, 5, 5, 5, 5	2, 0, 0, 0, 0, 2.5, 3, 0, 0, 0, 5, 5, 0, 0, 2, 0, 4, 1	0, 0, 5, 5, 5, 2, 5, 3.75, 0, 0, 5, 0, 3, 5, 0, 4, 4
	T <sub>CR</sub> =63	T <sub>ID</sub> =7.50	T <sub>TR</sub> =39	T <sub>CW</sub> =71.25	
5-KF-DBS T <sub>5</sub> =168.75	5, 5, 5, 5, 5, 3, 3, 5, 0, 5, 5, 5, 5, 5, 0, 0, 5, 0, 0	3.5, 1, 3, 0, 0, 0, 0	5, 5, 2.5, 2, 5, 5, 5, 0	5, 5, 0, 5, 0, 4.75, 3, 0, 0, 0, 5, 5, 0, 0, 2, 0, 3, 0	0, 0, 5, 5, 5, 2, 5, 2, 0, 0, 2, 0, 0, 2, 0, 0, 0
	T <sub>CR</sub> =66	T <sub>ID</sub> =7.50	T <sub>TR</sub> =29.50	T <sub>CW</sub> =65.75	
6-UW-DM T <sub>6</sub> =177.25	3, 5, 5, 5, 4, 5, 3, 3, 3, 3.5, 5, 5, 5, 5, 5, 0, 0, 5, 5, 0	1, 0, 3, 5, 0, 0, 1	5, 5, 2.5, 2, 0, 5, 5, 5	4, 4, 0, 0, 0, 4.75, 5, 0, 0, 2, 5, 5, 0, 0, 2, 0, 5, 5	0, 0, 5, 5, 5, 2, 5, 2, 0, 0, 2, 0, 0, 0, 0, 0, 0
	T <sub>CR</sub> =70	T <sub>ID</sub> =10	T <sub>TR</sub> =29.50	T <sub>CW</sub> =67.75	
7-UC3M-DADB T <sub>7</sub> =182.75	5, 4, 4, 4, 5, 5, 5, 5, 2, 5, 5, 5, 5, 5, 0, 0, 5, 5, 5	4, 1, 3.75, 2, 0, 0, 0	5, 5, 2.5, 2, 0, 5, 5, 2	5, 5, 1, 0, 0, 2.5, 5, 0, 0, 0, 5, 5, 0, 0, 0, 0, 5, 2	5, 0, 5, 5, 5, 2, 5, 2, 0, 0, 2, 0, 0, 0, 0, 0, 0
	T <sub>CR</sub> =79	T <sub>ID</sub> =10.75	T <sub>TR</sub> =26.50	T <sub>CW</sub> =66.50	
8-UPM-BD T <sub>6</sub> =166	3, 4, 4, 5, 5, 4, 5, 5, 3.5, 5, 5, 5, 5, 5, 0, 0, 5, 1, 0	4, 1, 3, 2.5, 0, 0, 0	5, 5, 2.5, 2, 0, 5, 5, 0	4, 4, 3, 3, 0, 2.5, 5, 0, 0, 0, 5, 5, 0, 0, 2, 0, 5, 2	0, 0, 5, 0, 5, 2, 5, 2, 0, 0, 2, 0, 0, 0, 0, 0, 0
	T <sub>CR</sub> =69.50	T <sub>ID</sub> =10.50	T <sub>TR</sub> =24.50	T <sub>CW</sub> =61.50	

Beyond the plain scores that can be seen in Table 3 and the line chart shown in Figure 1, which rank first the Saylor's courseware, as being the most suitable for self study of novice learners, we see that the resources that have scored the highest are the ones that are very involved with their learners (offering even some sort of certificate of completion), and that facilitate engaging, deep learning experiences supported by well designed instructional materials. What it is interesting is that in one of our previous works, before using a rubric for measuring each criteria on a scale from 0 to 5, our opinion was that the Stanford-Widom course was "the best" due to the commitment and enthusiasm of Professor Widom and her team, especially her personal involvement, her keeping in touch on a regular basis with the learners "enrolled" in her open class, her care for keeping things going on smoothly and beneficially for learners worldwide. Of course, the other resources are also valuable to support individual learners interested in learning databases, but they all lack the direct connection with and steady support for their users.

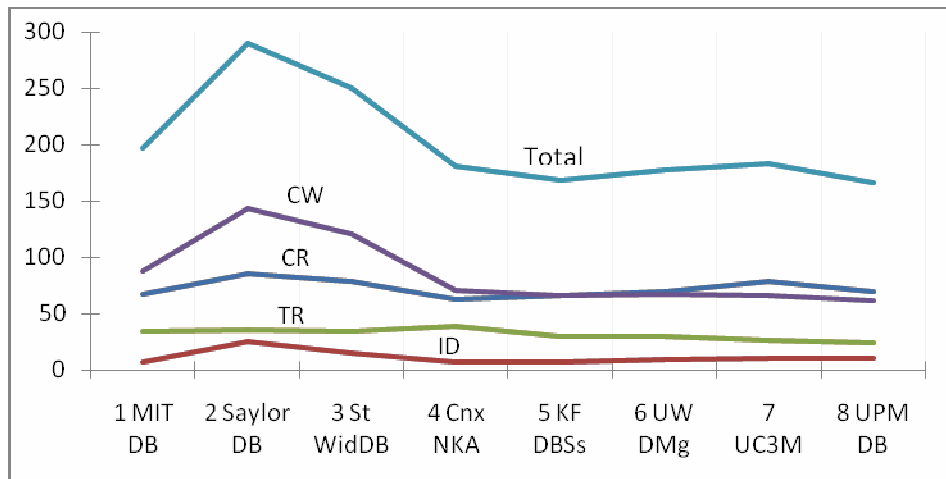


Figure 1. Graphical illustration of the evaluation and comparison matrix

However, the highest total score obtained by the Saylor's courseware is not accidental, in our opinion being due to the strong commitment of the Saylor team to "build" an open online university without walls, where independent learners are ought to return with pleasure and confidence that they can connect with the courseware materials and with peers in a meaningful, unique, transformative way, Foundation's goal being to offer to as many individuals as possible the opportunity to overcome the barriers of attending mainstream college education: fixed class schedule, physical distance to a campus, rising costs related to tuition, fee, and textbooks etc.

## V. CONCLUSIONS AND FUTURE WORK

In this work we have evaluated and compared eight open courseware on database fundamentals, based on our set of quality criteria, proving the validity of the quality model, and, learning, based on this experience, how to refine them towards a proper quality model and evaluation framework. New quality criteria have proved to be necessary, such as: potential for reusability, support for developers etc. Moreover, the need to develop a prototype for the quality assessment for open educational resources and open courseware has become obvious. Only this way, the quality model would prove its usefulness, and it will be able to contribute to the emerging *global reflective open educational infrastructure*, which it is ought to fulfill learners' needs, both individually and collaboratively, and to support them and their communities on their quest for and social construction of knowledge throughout their life.

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