Analysis of Open Education Service Quality with the Descriptive-Quantitative Approach

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ABSTRACT
The concept of Open Education (OE) is based on the philosophy of e-Learning which aims to provide learning environment anywhere, anytime, and for anyone. One of the main issue in the development of OE services is the availability of the quality assurance mechanism. This study proposes a metric for measuring the quality of OE service. Based on extensive literature review about e-Learning service quality guidelines, as well as the observation of existing Open Education services, we formulated Open Education Metric (OEM). OEM consists of 37 indicators which are divided into six criteria: (1) Openness, (2) Benefit, (3) Delivery, (4) Learning, (5) Evaluation, and (6) Support. Evaluation scheme is designed to give a clear guideline in assessing the quality of OE service quantitatively. The evaluation results including score and category indicate the overall quality relative to a set of indicators. Trial of evaluation was conducted using the evaluation system based on OEM to test its performance in evaluating OE service quality in institutions. Three of OE services were evaluated with their scores.

Keywords: metrics; online learning; open education; service quality

INTRODUCTION

Open Education was first introduced by David Wiley in 2011 (Pisutova, 2012). Open Education has the characteristics of e-Learning where learning activities can be done at anytime and anywhere, coupled with the concept for anyone. The application of the concept of Open Education emphasizes on the openness of access to education for everyone in a large scale, for example, is a service Massive Open Online Course (MOOC). The application of the concept of Open Education varies greatly. It is not just limited to the MOOC. According Pisutova (2012) there are at least four categories of services: Open Content, Open Courseware, Open Educational Resources, and Open Teaching. Categorization is done by what is offered by a service. Variations which occur in more detail services, such as certification, the structure of lectures, presentation of lectures, open access, standards related to the lecture material, availability of information related to the course, the availability of technical assistance, availability of tutors in the learning and so forth.

In the context of Open Education, the absence of a model as a reference will make it hard for an organization to plan the steps to be taken to implement the service (Yuan, MacNeill, & Kraan, 2008). It also requires an evaluation mechanism to measure the extent to which the implementation of Open Education has been done, so it can be compared to other services. Prospective users of the service will be better informed if there is a large selection of quality benchmark information service.

Some maturity models related to e-learning and software engineering in general have ever been studied previously, for example, the Capability Maturity Model (Paulk, Curtis, Chrissis, & Weber, 1993), e-Learning Maturity Model (Marshall & Mitchell, 2002), e-Learning Process Maturity Model (Zhou, 2012), and Online Course Quality Maturity Model (Gu, Chen, & Pu, 2011). All of the maturity models are designed as the standard in the implementation process with the main purpose of guaranteeing and promoting the quality of the products or services produced. Maturity models provide guidance and the ideal standard of the results expected from the implementation of the process. If maturity models provide a thorough benchmark based on best and ideal practice, there is also a metric that does not directly provide ideal standards regarding expected results of a process. Metric emphasizes more on the evaluation of a process of the indicators that are designed and can measure the quality of the results. Some of the metrics that have already existed and are related to this research among which the e-Government Metric and the Web-based Application Quality Metric.

However, if the reference puts much emphasis on the aspect of a well-executed and documented policies or procedures that govern the process with a high level of complexity which is commonly found on maturity

models, it can potentially discourage the institutions initiative to implement the Open Education service. In addition, the measurement or benchmarking mechanism involving internal factors/social service providers is not always easy to do, for example, the institutional readiness factor in implementing e-Learning, the regularity of the process of designing the curriculum, user satisfaction, and so on. In other words, we need a reference (simple) which can also be used as a measuring instrument (metric) practical application of Open Education (practical) based on the facts that can be accessed via the internet.

Therefore, taking into account the need for quality assurance of Open Education services (Hylen, 2006; Yuan, MacNeill, & Kraan, 2008; Yuan & Powell, 2013), this study focuses to answer the following three research questions:

1. What are the indicators used in assessing the quality of service of Open Education?
2. How to make an evaluation based on these indicators?

Based on the research problem, a few objectives have been defined to be achieved from this research. The first is to identify indicators in assessing the quality of service of Open Education. The second is to formulate the Open Education metric for evaluating Open Education service. Open Education Metric (OEMs) are expected to contribute as a reference for the development and evaluation of services Open Education.

There are many aspects that can be extracted from the application of Open Education, and certainly not all aspects are discussed in this study. Based on the research objectives that have been set, taking into account the aspect of simplicity and practicality, we would then determine the limits of the research coverage. Here are some boundaries that define the scope of this study:

1. Criteria which will be discussed in the research are those covering the external/technical aspects (instructional presentation, open access, evaluation, technical assistance etc.), and not the internal/social aspects (institutional readiness, a standard procedure of education material production, institutional satisfaction, user satisfaction, and so on.) on the application of Open Education.
2. The indicators that have been selected can be observed directly through the internet for the services concerned. This study refers to the method used by Waseda e-Government Ranking in which the assessment is based upon the characteristics of e-Government services that can be accessed via the Internet independently.

RELEVANT LITERATURE REVIEW

E-Learning and Open Education

One of the definitions of e-Lea rning from previous researchers is the combination of educational functions and the provision of teaching materials through information technology or the Internet (Tzeng, Chiang, & Li, 2007). E-Learning is widely used by educational institutions as a reference to implement distance education, which make it synonymous with the term distance learning (Welsh et al., 2003). An educational service that implements e-Learning has a set of components that are closely interwoven. Based on research Selviandro (2013) regarding the service cloud-based e-Learning, it can be concluded that the main components that make up an educational service based e-Learning are an actor, data, applications, and infrastructure.

The concept of e-Learning that use information technology in the process of teaching and learning has changed the face of education, especially for such high levels of education at the university. Starting from the concept of e-Learning, we now apply the paradigm of Open Education. The basic philosophy underlying the Open Education is the same as the underlying e-learning, which is learning anytime and anywhere, but Open Education also greatly emphasizes the aspects 'for anyone'. It represents the philosophy of openness and sharing which are also an integral part of the process of formation and dissemination of knowledge (Wiley, 2011). Therefore, Open Education aims to expand access to knowledge to all corners of the world without being limited to differences in geographical, economic and social aspects, with Internet technology as the primary means.

Figure 1 illustrates the integrated concepts that are part of the paradigm of Open Education, the Open Content, Open Courseware, Open Educational Resources and Open Teaching (Pisutova, 2012). Arrows indicate the direction of development of the concept, which initially only emphasizes the sharing of learning materials (content sharing) on the concept of Open Content, which then becomes an online educational service that is integrated in the concept of Open Teaching. The development of this concept towards the implementation of Open Education which has a wider reach and offer more benefits to its users.

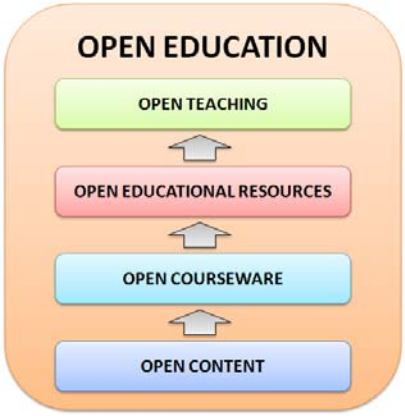


Figure 1. Paradigm of Open Education (adapted from Pisutova in 2012)

Furthermore, based on the existing definitions (Pisutova, 2012; Wiley, 2011), some aspects can be inferred to distinguish between the concepts of Open Content, Open Courseware, Open Educational Resources and Open Teaching. Table 1 shows two aspects that distinguish between these concepts, namely from the aspect of services presented in each concept and the benefits to be gained by an individual of service on each concept. Each concept has its own character in every aspect, and an enrichment and the refinement of the concept of the previous level.

Table 1. The difference between the concepts of the Open Education

Aspect	Open Content	Open Courseware	Open Educational Resources	Open Teaching
Service	Learning materials, for example in the form of text, video and animations	Learning material presented in the currency of teaching	Courseware coupled with other learning resources, such as tools and infrastructure	Online educational services, including materials and evaluation of learning
Benefits for Individuals	Science	Set science on a course	Science enriched by learning from the experience of other learning resources	Certification or college credit

E-Learning Maturity Model

Based on the work of a pioneer in the field of software engineering named Watts Humphrey, Paulk et al. (1993) creates a Capability Maturity Model (CMM). CMM is the solution to improve the quality and productivity of software development. CMM provides instructions for resolving the challenges caused by the inability of an organization to define and implement a systematic and structured development process. Based on benefits that can be obtained by applying the Capability Maturity Model, Marshall and Mitchell (2002) conducted a study to devise a maturity model for improving the quality of e-Learning. Thus, in principle, the E-Learning Maturity Model (EMM) is a modification of the CMM specifically to the field of information technology-based education items, namely e-Learning. Table 2 describes the objectives that are the focus at any level or degree of maturity EMM.

Table 2. Focus of Each Level in *e-Learning Maturity Model*

Level	Focus
0. Not Performed	There is no implementation of e-Learning
1. Initial	The process is still random, improvised or ad-hoc
2. Repeatable	E-Learning Objectives are clearly defined
3. Defined	Process development and operation of e-Learning clearly defined
4. Managed	Quality control over materials and learning outcomes of e-Learning
5. Optimizing	Continuous improvement effort on the quality of e-Learning

METHODOLOGY

The development stages in this study are generally divided into four phases: the requirement identification, analysis, design, and evaluation. This partition is intended to provide a roadmap so that research can be done in a structured and systematic way. A number of activities are conducted at each phase sequentially to avoid overlap, following the workflow of logical thinking by deductive reasoning. The workflow of the stages of this study is

illustrated in Figure 2.

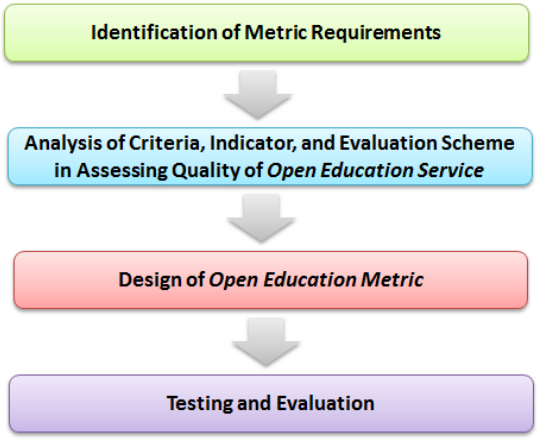


Figure 2. Research Workflow

Identification of Metric Requirements

At this stage we conduct a literature study, the observation and analysis aim to identify the things that are necessary out of a metric. This stage focuses on the existing standard of quality measurements (metric) which is related to the field of Open Education. Literature review is applied to better understand the number of concepts concerning the application of Open Education in the institutions. It also includes the observation of 'best practice' in Open Education services that already exist, for example the MIT Open Courseware, Coursera, EDX, Udacity, Futurelearn, and so forth. The analysis, synthesis, and interpretation have been made based on the literature and best practice. The results of the analysis are in the form of a number of characteristics that should be possessed by a metric created.

Analysis of Criteria, Indicators and Evaluation Scheme in Assessing Quality of Open Education Service

This stage is to determine the criteria that can represent the quality of Open Education service. Selection of criteria is one of the most crucial step in this study because it provides a foundation for the design metrics. The method used at this stage includes the analysis, synthesis, interpretation of literature, and observation of Open Education services that already exist as the best practice. The literature considered includes the publications in the area of Open Education, e-Learning, maturity models, metrics and evaluation of e-Learning. The literature review has been conducted to provide a reference and basic theory in the preparation of metrics.

Design of the Open Education Metric

Furthermore, based on the criteria and potential indicators that have been acquired, we can design an evaluation model or scheme of quantitative assessment to measure the quality of service of Open Education. Broadly speaking, the resulting metric is the result of the analysis, synthesis and interpretation of the results of the analysis in the previous stage. The results of the Open Education Metric design consist of criteria, indicators and evaluation schemes for measuring service quality of Open Education.

Testing and Evaluation

The trial of metrics is done assessing the quality of some Open Education services in the real world. The results of these tests are used to analyze Metric Open Education qualitatively. Furthermore, to provide an overview about the relevance and validity of indicators used in assessing OE service quality, expert and user judgment (5-10 people) was conducted. This also aims to reduce subjectivity and bias in the development of metrics, as well as giving additional perspective from the expert and user viewpoint. In this study, an expert is defined as those who have experience in e-Learning as a researcher, while also being familiar with the existing growth and features of Open Education services. In contrast, the user is defined as those who have experience in using e-Learning and Open Education services, but is not familiar with the e-Learning research field. Academic qualifications required for all experts and users is a Master degree holder, in order to ensure they have an adequate cognitive level that is required in analyzing the factors that affect the OE service quality.

FINDINGS

Metric Requirements

The concept of openness to educational resources is not new, and a lot of institutions have participated in the sharing of educational resources, such as MIT Open Courseware since the early 2000s. The growing interest in the Open Education concept, as well as the increasing awareness of its benefit to all parties involved, leads to

development of Open Education services in number. However, with the number of services that have been or will appear in the future, we need a guideline to ensure the quality of this services (Hylen, 2006; Yuan, MacNeill, & Kraan, 2008; Yuan & Powell, 2013).

Maturity model is an example of a guideline that is generally interpreted qualitatively, which contains standard guidelines in the implementation process, the ideal characteristics, and the ideal results expected from a process. Meanwhile, one example of the guidelines that are usually analyzed quantitatively is metric, with a focus on measuring the quality of observed characteristics quantitatively. The research was conducted by considering a number of maturity models and metrics that have already existed, namely in the field of software development, e-Learning, and e-Government.

Table 3 summarizes a number of problems and needs to be addressed by a metric, in order to assess the quality of Open Education service. Therefore, Open Education Metric will be formulated based on this set of problems and needs.

Table 3. Requirements Identification of the Open Education Metric

Problem	Need	Solution
Institutions do not understand the concept of service in detail but would like to try to implement the service as a pilot project	Practical guidelines for the implementation of Open Education services	*Open Education Metric*
Lack of standard implementation guideline for service provider or prospective service providers	Examples of standard implementation	
Service provider's difficulties in evaluating the implementation that has been done	Evaluation standard for service quality across relevant aspects	
The absence of a mechanism to compare the quality of a service with other services (benchmarking)	The mechanism to measure the quality of relevant aspects quantitatively	
Lack of specific guideline regarding the quality of Open Education service; although there are many references for the quality of e-Learning, we need to consider if all is relevant and to be implemented	Guidelines about the quality of the Open Education service by utilizing the e-Learning quality benchmark that is readily available and relatively well-established, as its base	
Users and providers who usually prefer the practical aspect is difficult to interpret qualitative evaluations	The mechanism to quantitatively evaluate the service quality	
Guideline about the quality of e-Learning that is intuitively also applicable for Open Education, still too abstract and too broad for interpretation	Open Education service quality guidelines with practical indicators and clear directions	

Key Criteria and Indicator of Open Education Service Quality

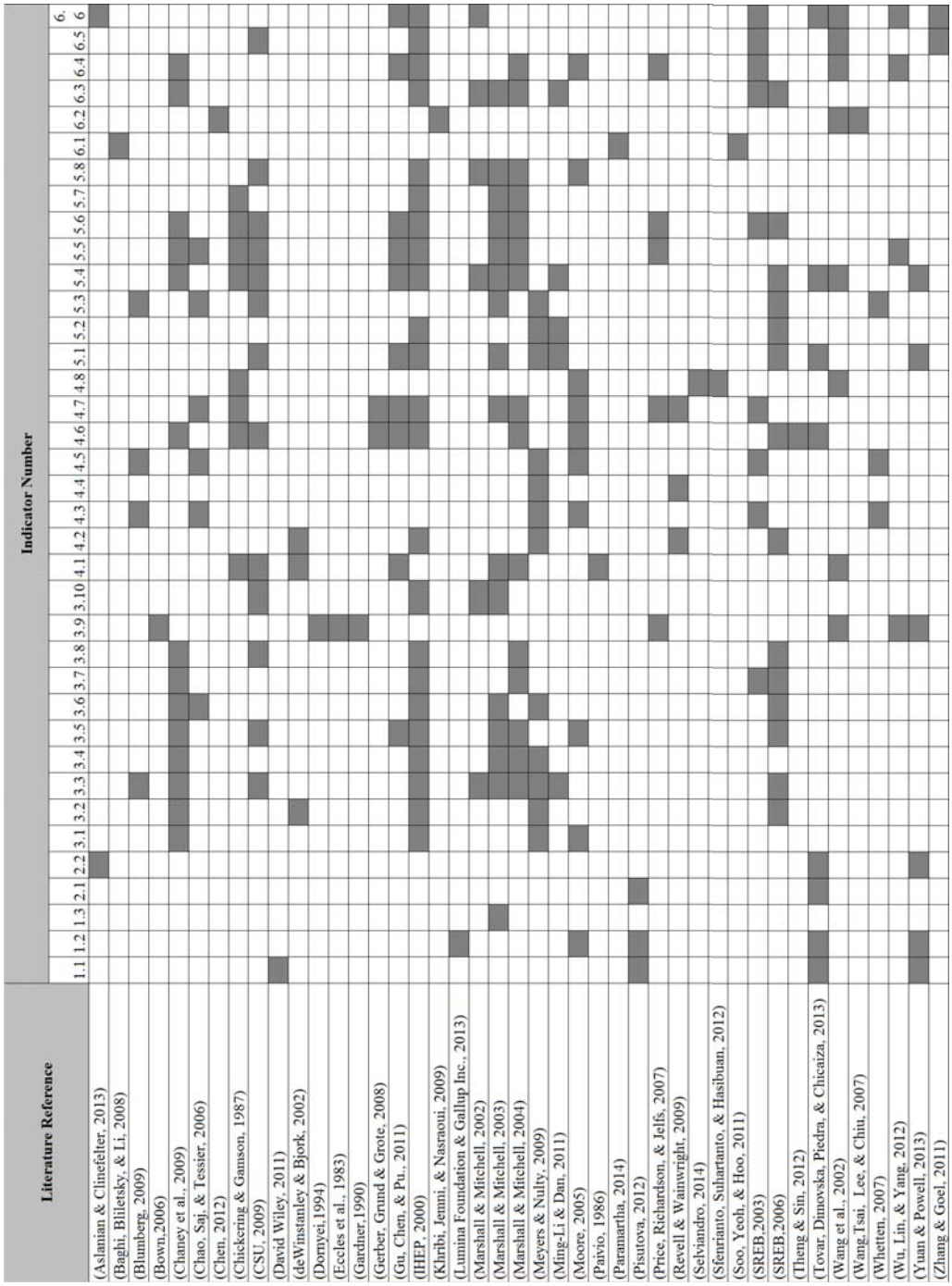
There are many different criteria that can represent several aspects of Open Education services, which can be measured and considered as the quality of a particular service from the user perspective. Among numerous criteria found on literatures (e.g., Blumberg, 2009; CSU, 2009; Gu, Chen, & Pu., 2011; IHEP, 2000; Khan, 2001; Marshall & Mitchell, 2002, 2004; Ming-Li & Dan, 2011; Moore, 2005; Pisutova, 2012; Price, Richardson, & Jelfs, 2007; Shelton, 2011; Wiley, 2011), there are six main criteria that we proposed and considered to be the focus of this study: Openness, Benefit, Delivery, Learning, Evaluation, and Support. Each criterion represents the quality of service of Open Education from different aspects. Table 4 illustrates reference from which each criterion synthesized.

Table 4. Literature Reference of Key Criteria

Literature Reference	***Openness***	***Benefit***	***Delivery***	***Learning***	***Evaluation***	***Support***
(Blumberg, 2009)			■	■	■	
(CSU, 2009)			■		■	■
(Wiley, 2011)	■					
(Gu, Chen, & Pu., 2011)					■	
(IHEP, 2000)				■	■	■
(Khan, 2001)					■	■
(Marshall & Mitchell, 2002)						■
(Marshall & Mitchell, 2004)				■	■	
(Ming-Li & Dan, 2011)				■	■	■
(Moore, 2005)	■		■	■	■	■
(Pisutova, 2012)	■	■				
(Price, Richardson, & Jelfs, 2007)						■
(Shelton, 2011)				■	■	■

Then, we conduct an analysis of indicators related to each criterion. Each indicator synthesized from extensive literature review of previous work related to e-Learning, while also considering the nature of Open Education concept. Characteristics of existing Open Education service also serve as a reference to ensure that each indicator is reasonably relevant. Table 5 illustrates reference from which each indicator synthesized from previous work.

Table 5. Literature Reference of Indicator



Based on extensive literature review and analysis, we construct a set of criteria and indicator as a reference for assessing Open Education service quality (see Table 6). Each indicator also can be viewed as a factor to be considered when creating Open Education service. It is fair to say that these indicators might not give a complete coverage to service quality. However, we proposed that such indicators will serve as an initial step toward discussion of a more complete and detailed service quality measurement. Together with the evaluation scheme, this set of indicator form as an Open Education Metric which is expected to describe the quality of Open Education service in quantitative and quantitative manner.

Table 6. List of Criteria and Indicator

Criteria	Indicator
Openness	1.1. The service can be accessed by everyone
	1.2. All features freely accessible
	1.3. Service available in international language
Benefit	2.1. There are comprehensive education services
	2.2. There is certification or credit granted for learning effort or outcome
Delivery	3.1. Learning materials are classified based on the field of science
	3.2. Description about a course is available
	3.3. There is a definition about the aim and expected outcome of a course
	3.4. There is an information about knowledge or technical prequisites for a course
	3.5. List of scientific resource related to a course is available
	3.6. Information about learning evaluation mechanism for a course is available
	3.7. Detailed schedule of learning activity for a course is available
	3.8. Information to obtain guidance about a course is available
	3.9. There is a mechanism to motivate student in finishing a course
	3.10. Structure of each course designed in consistent manner
Learning	4.1. There is a wide variety of learning materials
	4.2. A course is structured into several topics as learning units
	4.3. Topics of a course directly related to the course title and description
	4.4. Topics sequentially arranged based on logical ordering
	4.5. Resource available for each topic/course directly related to its topic/course
	4.6. Facility for communication and discussion is available
	4.7. The use of communication and discussion facility is encouraged throughout learning process
	4.8. Learning is personalized to cater individual learner characteristics
Evaluation	5.1. There are materials to evaluate learning outcomes
	5.2. Evaluation material is available for each course
	5.3. Evaluation material properly address the content and objective of a course
	5.4. Evaluation is conducted to assess the learning outcome in each course
	5.5. The service provide feedback to learner based on evaluation of learning outcome
	5.6. Feedback given within a reasonable or definite amount of time since the evaluation conducted
	5.7. There is a standard of learning outcome in each course
	5.8. There is a mechanism for learner to give feedback to service provider
Support	6.1. Features for searching by keywords are available for: materials, subjects, and forums
	6.2. Service provide recommendation of related course or learning resource
	6.3. Technical support is available
	6.4. Learning tutor for a course is available
	6.5. Profile of course or resource author is available for learner's reference
	6.6. Course is created and guided by a competent tutor or teacher

Evaluation Scheme of the Quality of an Open Education Service

In order to make the indicators of the metrics previously defined able to represent the quality of an Open Education service, it required an evaluation scheme. In this study, we have proposed a scheme on a qualitative assessment of each indicator by classifying the applicability of each indicator into four different levels that do not overlap.

Broadly speaking, four of these levels are Level 0: Not Performed (not available), Level 1: Initial (already begun

to be applied to a small extent), Level 2: Delivered (mostly already applied), and Level 3: Managed (already fully implemented). Qualitative evaluation is done by comparing the existing implementation of a service against the circumstances described in each level of an indicator. Table 7 below contains a specific description of each level of the application on each indicator.

Table 7. Examples of a Qualitative Assessment Scheme of Open Education Metric

Criteria	**Indicator**	**Level 0**	**Level 1**	**Level 2**	**Level 3**
Openness	1.1 The service can be accessed by everyone	Can only be accessed if becoming a member of an education institution	Yes, but not for all learning materials	Yes, for all learning materials	Yes, for all learning materials, with the right to modify and redistribute
Benefit	2.1 There are comprehensive education services	Standalone and unstructured materials	Unstructured materials suitable for a learning purpose	Structured learning materials, packed per subject of interest	Structured learning materials complemented with a learning activity as an online class
Delivery	3.1 Learning materials are classified based on the field of science	No classification exists	Classification exists for small fraction of all learning materials	Classification exists for most of all learning materials	Classification exists for all learning materials
Learning	4.1 There is a wide variety of learning materials	Only textual learning materials available	Multimedia learning materials (video/audio/simulation) available for a small fraction of subjects	Multimedia learning materials (video/audio/simulation) available for most of subjects	Multimedia learning materials (video/audio/simulation) available for all of subjects
Evaluation	5.1 There are materials to evaluate learning outcomes	No evaluation materials available	Evaluation materials available for a small fraction of subjects	Evaluation materials available for most of subjects	Evaluation materials available for all subjects
Support	6.1 Features for searching by keywords are available for: materials, subjects, and forums	All is not available	Yes, only one out of the three items: materials, subjects, and forum	Yes, only two out of the three items: materials, subjects, and forum	Yes, all of the three items: materials, subjects, and forum

Open Education metric also designed to be able to map a service into concepts in Open Education paradigm (Open Content, Open Courseware, etc.). The objective is to assign a proper category so that it represents characteristic of a service in general. Based on assessment of indicator 1.1, we can categorize whether a service is an open or closed service, which means whether it is open for anyone to participate or only allow a closed group of people to access. Then, based on assessment of indicator 2.1, we can categorize whether a service belong to “Content”, “Courseware” or “Teaching” provider. In context of indicator 2.1, Level 0 and 1 represent a content provider, Level 2 represent a courseware provider, while Level 3 represent a teaching provider.

Furthermore, to establish a metric that also can provide quantitative information, we have proposed a quantitative assessment scheme. The quantitative scheme is basically made by assigning a weight for each level of implementation and a maximum score for each indicator. The value of service quality on a particular indicator is calculated by multiplying the weight with the indicator’s maximum score. The value of service quality on a

particular indicator is calculated by multiplying the weight with the indicator's maximum score. The weight at every level of implementation serves as a multiplier so that the indicator's value represents the real conditions of the Open Education service.

Currently, we can only assume that each of the criteria has the same contribution to the overall quality of service, which is why each criterion has the same maximum value. Scores for individual indicator of each criterion are calculated by dividing the maximum score of each criterion by the total number of indicators related to a particular criterion. This scheme's calculation model ensures that the maximum value that can be obtained for any service remain the same, although there is a change in the total number of indicators or levels. In this study, the proposed maximum value that can be obtained for a service is 1000. Table 8 shows the example of quantitative assessment scheme details on the Open Education Metric.

Table 8. Example of the Quantitative Evaluation/Scoring Scheme

Criteria	Indicator Number	Weight				Score of Maximum Indicator	Score of Maximum Criteria ∑Weight*Score
		Level 0 (min-max)	Level 1 (min-max)	Level 2 (min-max)	Level 3 (min-max)		
Openness	1.1	0.00-0.25	0.26-0.50	0.51-0.75	0.76-1.00	55.56	166.68
	1.2	0.00-0.25	0.26-0.50	0.51-0.75	0.76-1.00	55.56	
	1.3	0.00-0.25	0.26-0.50	0.51-0.75	0.76-1.00	55.56	
Benefit	2.1	0.00-0.25	0.26-0.50	0.51-0.75	0.76-1.00	83.34	166.68
	2.2	0.00-0.25	0.26-0.50	0.51-0.75	0.76-1.00	83.34	
Delivery	*Distribute score evenly across indicators of the same criterion*						1000/6
Learning	*Distribute score evenly across indicators of the same criterion*						1000/6
Evaluation	*Distribute score evenly across indicators of the same criterion*						1000/6
Support	*Distribute score evenly across indicators of the same criterion*						1000/6
						Maximum Service Score :	~1000

The appropriate quantitative assessment scheme, is that the higher the level of implementation of the service, the higher the scores. Each of the indicators on the same criteria have the same maximum score. Each criterion has the same contribution to the total maximum value. The difference in the maximum value of the criteria at the second decimal digit occurs because the indicator score is rounded to two decimal points to simplify the presentation. The difference of the maximum value calculation scheme happens because of the same thing. Nevertheless, the differences are relatively insignificant on value criteria and the overall value is not more than 0.01%.

Testing and Evaluation

In line with the purposes of an Open Education Metric, which is to measure the quality of OE services as well as classifying them into a relevant Open Education category, we tested the metric applicability to assess existing OE services in the real world. The outcome of this evaluation includes the score and category of the OE service evaluated. The score can be viewed in overall or in detail per criterion/indicator, which depends on viewpoint intended. The category of an OE service represents which category it belongs to in Open Education concepts, which should be one of Open Teaching, Open Education Resources, Open Courseware, or Open Content. Assessment of the OE service quality was conducted manually, facilitated by the evaluation system. The OE services tested in this study hosted by two reputable educational institutions in Indonesia and have considerable number of materials available. Three of the OE services tested are:

1. Institution A's Open Courseware
2. Institution B's Massive Open Online Courses (MOOC)
3. Institution B's Enrichment Material

Then, based on the evaluation result of each OE service tested, we can rank them according to the quality score obtained. Table 9 shows the ranking, the total score, and the category of each OE service tested. This score represents the quality of each OE service toward ideal Open Education implementation.

Table 9. Example of Ranking of OE Services based on Evaluation Results

Ranking	Service	Total Score	Category
1	Institution B's MOOC	705.91	Open Teaching
2	Institution A's Open Courseware	523.97	Open Courseware
3	Institution B's Enrichment Materials	511.13	Open Content

Figure 5 shows the comparison of the quality of the three OE services tested in this study. The classification of OE services into categories is not intended to represent a hierarchy, but only to indicate the nature of OE services provided. Thus, it should not be interpreted that one category better than other categories in every aspect. For example, Institution B's Enrichment Material perceived better in terms of openness than Institution A's Open Courseware. This is because the first one provides open access for everyone to all of its materials, in comparison to Institution A's Open Courseware that only allow public access to a small fraction of subjects. Another example, Institution B Enrichment Material perceived better in terms of evaluation rather than Institution B's MOOC. This is because each material in Institution B's Enrichment Material is always accompanied by an evaluation rather than online classes in Institution B's MOOC which does not always provide an evaluation for each subject.

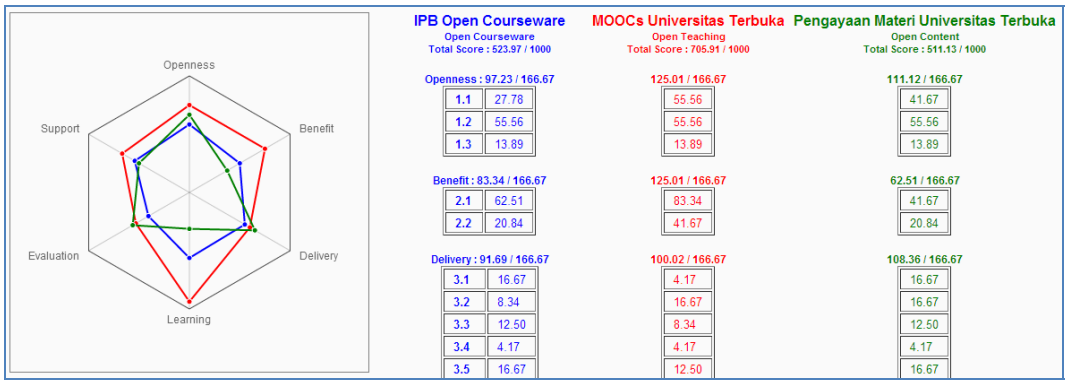


Figure 5. Example of Comparing OE Services Quality within Evaluation System

Performance of the *Open Education Metric* as a measurement tool can be reviewed from several aspects, such as applicability, clarity, and quantifiability. This review is considered based on metric performance in assessing quality of existing OE services that we did previously. Table 10 provides the description of the *Open Education Metric* review against these three aspects.

Table 10. Qualitative Evaluation towards Open Education Metric Designed

Aspect	Explanation
Applicability	Evidently, the *Open Education Metric* is able to assess the quality of OE services in the real world, with the score and category of OE services as the ultimate viewpoint.
Clarity	It can be observed that the *Open Education Metric* provides a set of indicators with clear intention, and a non-overlapping indicator level which each assessor to determines the appropriate implementation level for an OE service evaluated
Quantifiability	The *Open Education Metric* is able to translates OE services quality into a quantitative score, which is useful for the benchmarking and ranking of existing OE services.

Expert judgment data were obtained by using a questionnaire in a form of Likert-type items which contain 37 questions related to the relevance of each indicator to determine the quality of OE services. Each question consists of three types of responses: agree, neutral, or disagree. If an expert votes agree then it can be interpreted that the indicator is relevant to indicate OE service quality, and vice versa. In this study, we have obtained judgment from seven experts, and can be concluded that they all agree with the relevance of most of the indicators.

User judgment data were obtained with the same set of a questionnaire used in expert judgment collection. In this study, we have obtained judgment from six users and can be summarized that most of the indicators considered to be relevant by most of the users.

CONCLUSIONS

One of the main issues in the development of Open Education (OE) services is the availability of the quality assurance mechanism. This research aims to proposed a guideline to evaluate the quality of OE services. This evaluation result is important as a reference in the development of services, for evaluating existing services, and for benchmarking to compare the quality among OE services.

Open Education Metric proposed consists of criteria, indicators, and the evaluation scheme. There are 37 indicators proposed and divided into six criteria: (1) Openness - 3 indicators; (2) Benefit - 2 indicators; (3) Delivery - 10 indicators; (4) Learning - 8 indicators; (5) Evaluation - 8 indicators; (6) Support - 6 indicators. Each criterion represents different aspects in viewing the quality of OE service, while each indicator of a criterion elaborates related aspect into specific point. Each indicator designed in such a way that it can be independently observed on OE service via internet. In this study, each criterion has been assumed to have equal contribution to the overall OE service quality, while each indicator has the same contribution to its criterion score. The maximum score proposed for each OE service is 1000, in order to make it consistent and comparable.

Furthermore, we conducted evaluation based on the *Open Education Metric* to test its performance in evaluating OE service quality in the real world. Three of OE services evaluated including Institution A's Open Courseware, Institution B's MOOC, and the Institution B's Enrichment Materials. The evaluation results including score and category that indicate the overall quality of each OE service. The advantages and disadvantages of each OE services can be inferred to in detail by doing an analysis per criterion or per indicator. These results show that the *Open Education Metric* is capable to evaluate OE service quality into quantitative notion, while providing the adequate description of quality in detail.

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