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# Quality Model for Massive Open Online Course (MOOC) Web Content

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***Abstract*— With the philosophy of providing open education to all, Massive Open Online Course (MOOC), which introduced in 2006, has been through its first decade. Despite its popularity and worldwide acceptance, MOOC faces a few criticisms about the weaknesses of its content such as lack of clarity, unstructured, poor design and lack of fundamental initial requirements. This caused by the paucity of understanding among content providers about the facet of qualities contributes to the content. There are some previous efforts to improve the quality of MOOCs, but none focused on the content from the content providers or experts' view. As a result, most of the vital internal quality factors are neglected. Besides, the operational definition for the MOOC content quality factors is still missing or not well-defined. Therefore, this research proposes a quality model for MOOC web content as a content provider's reference to develop quality MOOC content. In order to achieve that, three basic elements were implemented which is the content's provider perspective, MOOC content quality dimensions and MOOC content quality factors. Development of MOOC content quality dimension is based on 7C's model and PDCA for continuity, while the determination of factors involves the process like a revision of the possible factors from literature, factors combination and categorization. This proposed hierarchical model tends to make MOOC's learning more optimistic and beneficial to the learners through the development of high-quality content.**

***Keywords*— web content; quality model; MOOC quality; content provider; hierarchical model.**

## I. INTRODUCTION

Massive Open Online Course (MOOC) has become a popular medium of teaching and learning since it was first introduced in 2006. The main philosophy is to allow societies to achieve quality learning materials from any institutions or courses which they do not have the opportunity to join. MOOC learners are not only capable of enhancing their knowledge through the concept of lifelong or informal learning but obtain credentials or certificates equivalent to conventional learning [1]. Quality is essential for MOOC platforms in order to maintain a learner's motivation, the developer's productivity, and the institution's reputation. Without denying the efforts of MOOCs providers in improving the quality of the platform, the course development along with its contents have yet to reach the level of sophisticated architecture which adapts the need of learners individually. Various quality models have been proposed to fulfill the gap such as 7C's learning design framework [2], OpenupEd Quality Label, and MOOCs Quality Reference Framework [3]. Nevertheless, such efforts are not enough as MOOC requires more detail and intelligence works mainly on the side of content development.

Numerous academic papers have highlighted the importance of MOOC content. Structured and explicit content contributes to learner's retention [1] [4]. The web content must be perceived as a non-temporal and nonperishable product, in which the quality needs to be protected [5]. Defining and measuring quality factors can assist the content developer in understanding the right facet of quality which subsequently improves the MOOC content. The proper design of MOOC content is fundamental as it commits hundreds of hours from the development team to produce the quality one. Since MOOC by nature is public and failure is not an option, continuous quality improvement is proven to reduce risk of content failure by its weaknesses. Content is also one of the factors that maintain the trust of learner, which possible to maintain their believability towards MOOC credibility [6].

This research proposes a quality model for MOOC web content as a reference to content providers to develop the content with relevant and quality features. Learners understand the functionality and external quality of the content, but content providers or developers have a better understanding of the internal qualities which is required during the development phase.

### A. Problem Statement

Despite its popularity, MOOCs still face various criticisms on poor design and weaknesses of content [7]–[9] point out the lack of awareness among MOOC content developers to develop quality content that adheres to the basic principles of massiveness and openness. The larger the audience, the more heterogeneous and diverse it is which becomes more complicated to address. Unfortunately, content providers seem to neglect this factor and continue to develop the "one-size-fits-all" content which lacks engagement and collaboration features [10]. Besides, most learners unable to adapt the format of a MOOC course due to its structural weaknesses, vagueness and unclear content [11] [12]. This led to the issue of usability which sometimes being worsened by the poor textual and graphical design including the dynamic elements [13]. In dealing with diverse learners, most content providers deserted neat and strategic preparation before development, making MOOC teaching to become one-way approach [14]. This is proven as most of the current MOOC content lack fundamental initial requirements such as the topic's relevance and objective clarity. Other weaknesses pointed out in the previous literature are unclear lengthy video, unattractive design and lack sense of identity [15].

There is an enormous effort to improve the quality of MOOC content through the development of frameworks and models [16], but most were focused on learner's persistence and observation, lack of rigor factors and metrics [17]. Furthermore, the evaluation of previous MOOC's quality merely comes from the learner's perspective and less from the view of the experts or content providers [18]. The quality model which focuses on web content from the content provider's perspective, has never been suggested. As a result, most of the current quality indicators only emphasized external factors while neglected most of the pertinent internal factors such as maintainability, portability, and continuity. The quality measures must take into consideration the diversity among MOOC stakeholders [19]. Perspective from end-user may represent some of the external quality and quality in use, while the view from the developer represents both of it, including internal quality which is pertinent along with the construction phase [20]. There are differences in perceptions between MOOC developers and learners towards things like experience and interaction [21].

The operational definitions (OD) and the quality dimension of the quality in the context of MOOC content are still missing and some are not well-defined. OD is one of the cores and primary requirements of a quality model as it provides a detailed description of the variable [20]. It assists all stakeholders to understand and evaluate a factor evenly. There is also a lack of evidence on MOOC quality dimensions in designing content. Quality dimensions are essential in the strategy of acquiring substantial quality factors, as suggested by David A. Garvin who proposed eight dimensions of product quality management [22]. Even there is an effort towards the MOOC quality dimension, but it is too general, diverse and not focus on the content [23].

Content quality weakness is not just issued to the developers or content providers but involves learner's motivation, the completion rate and the institution's reputation [1]. From the latest figure, MOOC completion rates are still below the educational standard, which is merely 13% [24]. Despite contradictions among experts whether this figure accurately reflects the quality of MOOC, it shows that the trend of acceptance is stagnant over the last 8 years. Since content is recognized as one of the critical dimensions of the MOOC quality, [25], the comprehensive quality model of content is essential and timely.

### B. Understanding the Quality of Web Content

ISO defines quality as the totality of featured characteristics of an entity that bear on its ability to satisfy a given need. With the definition, to have quality software, the requirements of it must be measurable, either be met or not [26]. In order to qualitatively evaluate the software quality, a quality model needs to be established. The quality model determines the perspective and the relationship between characteristics, sub-characteristics and attributes of any entity, which allow further evaluation required by the stakeholders [27].

Factor-Criteria-Metrics (FCM) models are one of the most notable and generally accepted for software quality evaluation. The model is based on a hierarchical model that decomposes the attributes into a set of quality factors. FCM quality factors can be assessed from a set of software-related measurements or any metrics. The well-known models based on FCM are the McCall model, Boehm model, and ISO/IEC 9126 model.

ISO/IEC 9126 is the first formal and standardized model proposed for software development and quality criterion. Developed in 1991, the quality model classifies software quality in a structured set of characteristics and sub-characteristics. It contains two parts of the quality model for a software product which are (1) Internal and external quality model (2) Quality in use model. External quality refers to how the functions, features and usefulness of the software as required by the stakeholders are met. Internal quality is related to the inner process of system development so that it can be maintained and improved effectively by the developers. It includes factors like effective coding, component reusability, complexity and duplication.

ISO/IEC 9126 become the foundation for the development of other FCM-based quality model proposed by previous literature. Some psychometric researchers proposed these three (3) generic steps in modeling the quality which is [28]:

- **Conceptualization:** Limiting the scope for constructs and producing sample items that represent the concepts considered.
- **Design:** involves investigation on measurement, whether it represents the actual constructs. The design process focuses on construct validity and reliability analysis.
- **Normalization:** Involves steps of subsequent **verification** and validation of the constructs.

Generally, web content defined as any textual, visual, or aural material experienced by a web application user [29]. The accelerated increase of Web applications caused the issue of guarantying and measuring the quality of web content [30]. For the user, it serves as a guarantor that scientifically approves the accessed information. As for the developers, the quality model can be guided in the

development phase while assisting them in indicating the readiness of content to be live.

The beginnings of the quality criteria of web content began in 1996 when [31] developed a hierarchical framework for data quality from the perspective of users. They categorized the data quality attributes into four (4) main categories which are intrinsic, contextual, representational and accessible. Intrinsic data quality (DQ) denotes that data have quality. Contextual DQ highlights the requirement that must be considered within the context of the task at hand. Representational DQ highlights the aspect of data formatting while accessibility DQ emphasizes on how a data can be accessed steadily. This framework is referred to by some subsequent researches related to data quality.

A study on content quality suggests three (3) key indicators to access the quality of content which is content authority, content currency and content stability [32]. Then several ideas about the content (also define as information) quality constructs are proposed like Web Qual™ and Web Quality Evaluation Method (WebQEM). These models focus on perceptible factors like navigation, interface and reliability, rather than product factors like coding quality and design. However, the real deal comes when a study identified a set of attributes relevant to assess web data quality and being validated by a team of experts and web developers [30]. They organized 33 data quality attributes into a hierarchical structure. However, the attributes did not conform to a usable model. Function and content are two (2) different entities, which mixed-up to form web applications [33]. So, they propose to improve the newly issued ISO 25010, which replaced ISO 9126 by integrating information quality as part of its characteristics. They upgraded the previous study [30] by expanding the term "data" into "information," which has its purposes and context. The sub-characteristics of information quality are content accuracy, content suitability, content accessibility and legal compliance.

A study [34] expands the research of data quality [31] to the web application context. They categorized all relevant attributes to web data quality into categories developed by Wang and Strong which intrinsic (they put accessibility in this category), representational and contextual. [34] managed to get attributes for quality web applications but scoped to the health web application.

A study [35] points out the importance of usability for developers to develop responsive web applications. There are three concepts of design principles, including the manageability of information, interactivity of users, and aesthetic of interface. In the context of e-commerce, the web aesthetic factors have direct proportional with usability which is users perceive more aesthetically pleasing websites to be easier to use than less aesthetically pleasing websites [36].

### *C. Understanding the Quality of Online Learning web content*

The quality factors of any online learning system is not necessarily valid for MOOC since the scalability, openness, techniques, and level of self-regulated learning of both system is different [37] [38]. However, the study of quality in the context of online learning other than MOOC guided this research primarily in obtaining initial quality factors to develop the quality model. [39] identified and described the factors supporting the quality of Learner Generated Content (LGC) using the literature of case study and learner's perception. This study shows that the quality factors for LCG are based on three dimensions - content, format and process.

Besides models and frameworks, there are also benchmarking and guidelines proposed, which highlighted the quality of e-content. Malaysian Ministry of Higher Education (MOHE) has developed e-Learning Guidelines for Malaysian Higher Education Institutions to provide a set of standards and procedures in managing and administer the e-learning system. The factors stressed in the guideline are consistency, clarity, organized and presentable. Online Learning Consortium (OLC) offers tools to benchmark the quality of course design through Open SUNY Course Quality Review [40]. The objective is to support continuous improvements to the quality and accessibility of online courses. There are six quality dimensions to investigate which is (1) course overview and information, (2) Course Technology and Tools, (3) Design and layout (4) Content and activities (5) Interaction and (6) Assessment and Feedback. E-xcellence proposed as a benchmarking model for online education, developed mainly for the needs of educational institutions in Europe. There are six dimensions which is Strategic Management, Curriculum Design, Course Design, Course Delivery, Staff Support, and Student Support.

It is proposed to extend the ISO9126 model with specific e-learning quality factors [41]. They defined the quality characteristics of the e-learning system and integrated it with the current quality model. As the quality of e-learning closely depends on the content, they listed standard quality dimensions for Learner-Centered content, Granularity (Segmentation), Engaging, Interactive, Personalized, Consistence, Cooperative, and Quick Distribution.

The development of guidelines like from MOHE, E-xcellence, and OLC prove that efforts towards improvisation of e-Learning is actively implemented. Even most of it puts content as only part of the whole categories; it becomes de facto for the quality of online learning. Moreover, the model of content quality can be developed standalone [39].

### *D. Understanding the Quality of MOOC web content*

MOOC web content can be defined as any textual, visual, or aural material which experienced by MOOC users. There is consensus among MOOC practitioners that instructional videos are the main content which should be present in each of the MOOC courses [42]. Apart from instructor-generated material, web design is also part of the whole MOOC web content [29]. The web design process involves several elements such as page layout, content production, and graphic design. Defining content provider should be accompanied by instructors, instructional designers, video/media developers, graphic designers, software developers and project manager [43]. Instructors define the objective and progress of the content, also act as curators and the ones who need to appear in the instructional video itself. They are fit to become the project manager

themselves. Instructional designers help the instructor to storyboard the course, construct the detailed week-to-week plan, and link together all the sequence of activity. Video developers involve in recording and editing the video, which the main content of MOOC. The graphic designer's task covers a large spectrum from simple design formatting to draw a graphic diagram and illustration. Software developers manage and coordinate the design, development, deployment and maintenance of a MOOC platform.

In general, the concept of quality in MOOC is complex and diverse since it requires an evaluation from various perspectives. This is supported by [19] which proposed to adopt a relativist approach in the development of the MOOC quality model, which emphasizes the importance of context. [16] divide MOOC quality dimensions into four categories:

- Quality from the perspective of a learner
- Quality related to the MOOC pedagogical framework
- Quality related to the input elements such as design and content
- Quality based on outcome measures

Quality from the perspective of a learner requires their engagement in a quality evaluation involving expectations, requirements, behaviors, and self-paced. Some research provides a few examples of how the role of the learner being involved in the development of quality instruments [39], [44]. The second category requires teaching and support efforts to increase the learner's motivation and participation significantly. For instance, instructional design quality study is claimed to be a critical indicator and prerequisite of effective course [18]. Various reasons can potentially cause poor course design and one of them is the weakness of instructors and knowledge designers in mastering the latest teaching design principles or learning theories. The last category (based on outcome measures) involves direct measurement of learner's completion rate or achieving certification. However, this approach is criticized as it does not reflect the true MOOC quality [45].

This literature will focus on quality-related to input elements including web content. There are a few studies on MOOC quality content, which should be read in the context of the MOOC design model and the quality dimensions associated with it. As for now, there is none of it based on the perspective of content provider or developer. [2] proposes a quality approach especially to design a MOOC course named 7C's learning design framework as in Figure 1 below.

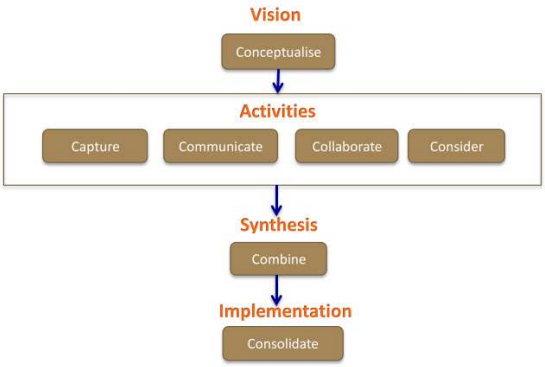


Fig. 1 The 7C's learning design framework by [2]

As depicted in Fig.1, four (4) stages of design such as visual which the activity is conceptualized, activities (capture, communicate, collaborate, consider), synthesis (combine), and implementation (consolidate). The advantage is it divides every phase of development according to the working stage, which the developer needs to conform. However, the framework less dynamic and more linear than the previous version of 7C's [46]. This is contrasting the nature of quality enhancement which should be systematic and iterative.

The set the criteria is subject to ensure the quality of MOOC design from the perspective of learners and teachers [47]. The criteria are listed by the following six design categories, namely instructional design, assessment, user interface, video content, social tools, and learning analytics. MOOC users evaluated its priority to MOOC design quality. The survey proved the importance of learning analytics and assessment as critical features in MOOCs. Despite suggesting criteria by its priority, this study does not come out with a comprehensive model to guide a developer.

The quality of the video is the most critical MOOC teaching content [15], [42]. Learner-instructor interaction is undoubtedly challenging to achieve when the ratio of them becomes too high like reaching 1: 1000. This situation is common to all popular MOOC courses which have a big number of learners such as TITAS from Malaysia MOOCs. One way to overcome this problem is to produce high-quality videos and pedagogical sound-based learning support for active learning. Thus, the presence of an instructor in a teaching process can be minimized and they can focus on other activities like forums or discussions.

The continuing efforts of certain parties like the European Association of Distance Teaching Universities (EADTU) to create a structured guideline of MOOC quality framework produced several products like OpenupEd for quality assurance upgraded from previous E-xcellence schemes. This framework is based on eight (8) quality dimensions like Openness to learners, Digital openness, Learner-centered approach, Independent learning, Media-supported interaction, Recognition options, Quality focus and Spectrum of diversity [16]. This model focuses on quality at institutional and course levels besides covering processes and not just products produced. This work is extended by placing content quality as part of an indicator to design an integrated system of evaluation for MOOC quality based on a quantitative, descriptive and sectional design [15]. The proposed indicator of content quality is up-to-date, personalization, the existence of activities to bring into play the skills that must be obtained and the existence of itineraries or review activities. They also point out the importance of systematic pedagogical and technical when designing the MOOC content.

Content preparedness and conceptuality as not all pedagogies are fit to be adopted in MOOC. MOOC's effective teaching starts with a comprehensive understanding of the MOOC environment before engaging in course design [14]. This is similar to the conceptualizing stage at the 7C's model [2] by adding the elements of content originality and accuracy before it is developed. Moreover, a study pointed out the importance of conceptual clarity to learner's course satisfaction along with instructor quality and format [48].

Experts consider MOOCs as extending the existing online learning applications by the introduction of two new dimensions, which are "Massiveness" and "Openness." However, most of the design models previously proposed do not focus on these two factors. Massiveness refers to the ability of content to receive large-scale participation. Openness is associated not only with the freedom of access to educational content, but also the sharing of scarce resources for quick distribution [41]. Openness in MOOC has four (4) different dimension which is Open Curriculum, Open Learning, Open Assessment and Open Platform.

The MOOC design model [23] is one of the few models which integrates input from users and providers to enhances its design and functionality. The dimension divided into three (3) categories, which are communication, learner-oriented and technologies. On the other hand, the ADDIE-based education design framework that aims to accommodate unique features of "Massiveness" and "Openness" in xMOOCs [49]. These two models focus more on external qualities.

The MOOC's design should adopt the diversity of motivations, intentions and targeted achievements by all parties involved, not only learners [3]. For that reason, the Quality Reference Framework (QRF) for MOOCs is developed, taking into account the interests of all stakeholders [21]. Its main aim is to develop and integrate various quality approaches from all dimensions, with more focus on learning, methodology, and evaluation processes. However, QRF's latest framework shows that contributions that focus on content from the perspective of internal quality are still lacking or less clear.

The importance of engagement as well as the instructor's presence in order to enhance learner's motivation while proven to ensure the quality of other factors is highlighted [8]. It involves more active participation from instructors and facilitators as well as ongoing communication. As MOOC involves a large number and diversified learners, maintaining engagement is not an easy task. In addition to instructional videos, various action is required in the form of communication, interactivity or gamification to boost engagement.

As a conclusion to this section, a quality model for MOOC content design is available to focus merely on the external qualities which mostly from the perspective of learners. From our study, the MOOC content quality model from the perspective of the content developer which involves the internal qualities, has yet to be proposed, and so the proper operational definition (OD) for MOOC content quality factors.

### *E. Content Provider Perspective*

The criteria used for evaluating the quality of one web application may not be useful for another [50]. This is supported by the study that proposed five perspectives of quality to reason why there is no universal agreement in the concept of quality [51]. The five perspectives are from transcendental, user, manufacturer, product, and value-based. Therefore, the development of a quality model from the perspective of the developer is sensible in order to cater to both external and internal quality attributes.

The McCall model works to bridge the gap between users and software developers by focusing on several software quality factors that consider the views of both parties. ISO/IEC 9126 is one of the first models introduced the aspects of quality in use, external quality and internal quality which take the developer's perspective into account. Some of the factors, along with its sub-factors in the ISO 9126 model, are related to the developer's perspectives which are maintainability, reusability and portability, as depicted in Fig. 2 [52]. The quality evaluation by untrained or experienced users can be questioned [50]. Apart from end-user judgment, the instrument validation from the perspective of experts or developers has also become a valuable alternative. The expert judgment approach typically starts with the identification of related characteristics, which then validated by them.

Dimensions of MOOC quality depend mainly on two variables: the MOOC's purpose and the perspective of the particular actor [19]. There are several stakeholders in MOOC, such as learners, facilitators, and content providers. There is a difference between the perception of the content providers and learners in developing quality content; besides, content providers frequently miss to understand the need of learners [21]. However, many studies agree that one of the most effective ways to evaluate content quality is from the content provider [53]. Unfortunately, the comprehensive quality model for MOOC content from the perspective of content providers has never been developed or defined in any research.

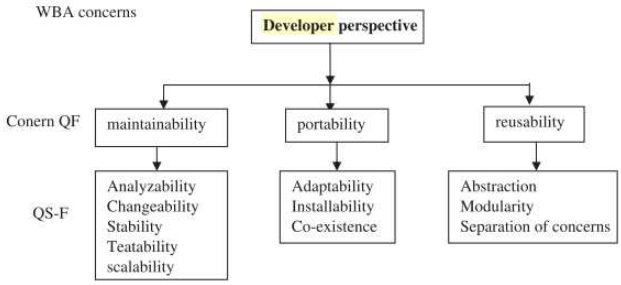


Fig. 2 Quality factors from the view of developer [52]

### *F. Continuous Quality Improvement*

The best use of MOOCs is in an offering of professional continuing education [54]. Continuity requires quality improvement to ensure the content stays relevant and accurate. also, point out the massive success of MOOCs lies in the MOOC's continuous experimentation [54]. It is quoted that "Quality enhancement for MOOCs is an iterative process, and design methodology at different levels of granularity can support this" [16]. In order to reflect the development stages of content, the proposed model should support continuous quality improvement which involves several factors like learner's feedback, support and future planning. Furthermore, in order to reflect the development stages of content, the model that supports continuous quality improvement is selected which is Plan-Do-Check-Action (PDCA) cycle. It is also known as the "Deming Cycle" (taken after the name of W. E. Deming) where this methodology enables quality to be systematically implemented to ensure continuous improvement can be fully achieved.

### G. *Conceptual Framework*

Conceptually, the implementation of this research can be summarized as shown in Fig. 3**.** The conceptual or proposed model guides the development of MOOC content as stated in the problem statement. The conceptual model will be validated and reevaluate to become a redesigned final model. Content development will be refined to meets the quality aspect based on the final model. As the new model applied, the current MOOC content with the issues of weaknesses will be migrated into a redesigned MOOC content.

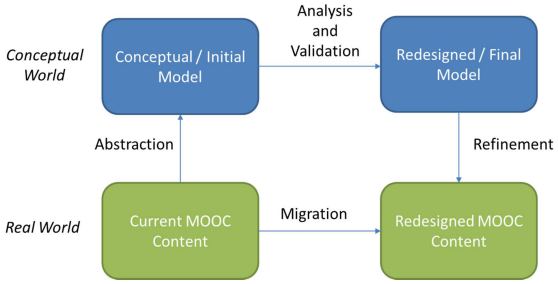


Fig. 3 The adaptation of the conceptual model in the real world

Back to the previous section, our objective is to define a set of factors that are relevant for MOOC content quality from the viewpoint of content providers. Taking all this consideration, we have work with three essential elements which are (1) Content providers' perspective (2) Content quality factors and (3) Content Quality Dimension as depicted in Fig. 4. The content provider's perspective element has been justified in the literature review (Section D).

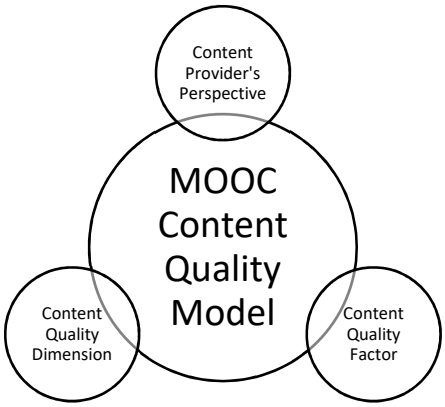


Fig. 4 The conceptual framework

The MOOC platform is a subset of web applications, which share a lot of features and functionalities in order to provide services. As a case in point, the Factor-Criteria-Model (FCM) has been generally accepted as a basis for a quality model not only for web applications but software. Therefore, the proposed model will implement this approach which also involves the development of quality characteristics and sub-characteristics (in this research, it will be referred to as categories and factors). With the idea of taking advantage of work already carried out and applying it to MOOC content, we decided to recompile quality factors proposed in the literature for web content, MOOC and any online learning applications and apply it to MOOC content.

In terms of quality dimension, it needs to be assessed within the boundary and intended use [30]. Therefore, it is necessary to incorporate the task context and the user's task requirements. To ensure that, we refer to the proposed MOOC development framework which is 7C's [2], since the model focuses on the development of MOOC content which divided into seven (7) work items. However, this model still needs to be adapted to other quality requirements that are specific to MOOC content obtained from literature reviews.

## II. Materials and Methods

Based on the three essential elements, we shall now describe the methodology to identify the MOOC content quality factors from the content provider's perspective. This consists of three main processes: (i) Review the existing and possible factors (ii) combining the set of factors and (iii) assigning factors to respective categories. The deliverable of these sub-phases is the initial model of MOOC content quality as depicted in Fig. 5.

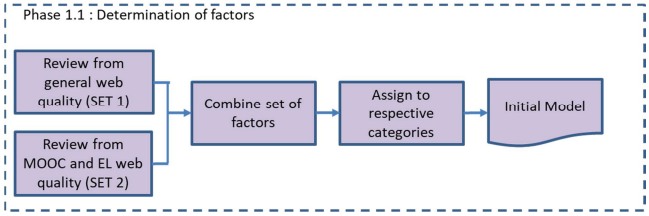


Fig. 5 The research design

The process of reviewing the existing and possible factors took advantage of work already carried out and applying it to MOOC content. By following the methodology [51], we reviewed the relevant literature and selected works in which MOOC content quality applies to our context. Their primary focus determined the relevancy of the papers whether it identifies the quality of MOOC, provides a solution for quality MOOC and provides any empirical evidence of identifying the factors. Possible quality factors were reviewed from literature related to web content, MOOC and any online learning applications that started 2010 to 2018. We have searched various online databases like IEEEXplore, Web of Knowledge, Elsevier's Science Direct, Wiley, JSTOR, ACM and Google Scholar. We named Set1 for the quality factors for web content as general with the search keywords of "Web Content Quality," "Data Quality," "Web Quality Model," "Information Quality," "Content Quality Assessment," "Web Content Quality Developer View" and "Web Quality Evaluation". Set2 is particularly for MOOC and online application content quality with the search keywords of "MOOC Quality Content", "MOOC content quality factor", "MOOC quality design", "MOOC quality course material", "MOOC Quality Content Provider Expert Developer View", "e-learning content quality factor and "MOOC course content quality".

On analyzing the names and definitions of all factors, we could reduce the number of it by executing the combination process to detect any redundancies. The redundancies can be classified as share the same meaning and naming. Referring to **Table 1**, rows were used to indicate the set of proposed

quality factors, while columns indicate the source of work which mainly from literature readings. It also shows the amount of reference/works that mapped to each factor. The ×, O and ⊗ symbols were used to represent how the factors combined: ⊗ indicates both the same meaning and naming, × indicates only the same meaning while O indicates only the same naming.

TABLE 1
CONDENSED LIST OF FACTORS FROM DIFFERENT RESEARCHES

| # | Quality Factors | Ref ID | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | No of Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Structured | | | ⊗ | | | | X | | | | X | ⊗ | ⊗ | | ⊗ | ⊗ | | ⊗ | ⊗ | | ⊗ | ⊗ | | ⊗ | ⊗ | ⊗ | | | ⊗ | | | | | | 15 |
| 2 | Accessible | | | | | | ⊗ | ⊗ | | | | ⊗ | | | | ⊗ | | | ⊗ | | ⊗ | ⊗ | ⊗ | | | | | | ⊗ | | | | | | 9 |
| 3 | Relevance | | ⊗ | ⊗ | | | X | | | | | | | | | ⊗ | | | | ⊗ | | | ⊗ | | | | | ⊗ | | | ⊗ | | ⊗ | | 9 |
| 4 | Comprehensive | | | X | | | | | ⊗ | | | | | | | X | | | X | | | X | ⊗ | | | | | | | | X | | ⊗ | | 8 |
| 5 | Consistence | | | | | | | | | | | | | ⊗ | ⊗ | ⊗ | | | ⊗ | | ⊗ | | ⊗ | | | | | | ⊗ | | | | | | 7 |
| 6 | Ease of use | | | | | | | | X | | | X | | | | ⊗ | | | ⊗ | ⊗ | | | ⊗ | | | | | | | | | | X | | 7 |
| 7 | Visual Aesthetics | | | | | X | | | ⊗ | ⊗ | X | X | | | | ⊗ | | | | | | ⊗ | | | | | | | | | | | | | 7 |
| 8 | Currency | | | X | | | | ` | ⊗ | | | | | | | ⊗ | | | | ⊗ | | ⊗ | | | | | ⊗ | | | | | | | | | 7 |
| 9 | Adaptable | | | | | | | ⊗ | | | | | ⊗ | ⊗ | | | | | | | | | | | | | | | ⊗ | | ⊗ | | | | | 5 |
| 10 | Changeable | | | | | | | ⊗ | | | | | X | | | X | | | | | | | | ⊗ | | | | | | | X | | | | | 5 |
| 11 | Legal Compliance | | | | | | ⊗ | | | | | | | X | | ⊗ | | | | | | ⊗ | ⊗ | | | | | | | | | | | | | 5 |
| 12 | Personalization | | | | | | | | | | | | | | | | | ⊗ | ⊗ | ⊗ | | | ⊗ | ⊗ | | | | | | | | | | | | 5 |
| 13 | Organized | | | | | | | | | X | | X | | | | ⊗ | | | ⊗ | | | X | | | | | | | | | | | | | | 5 |
| 14 | Readable | | ⊗ | | ⊗ | | | | ⊗ | | | | | | | | | | | | ⊗ | | | | | | | | | | | | ⊗ | | | 5 |
| 15 | Reusable | | | | | | | X | | | | | ⊗ | | | ⊗ | | | | | | | | | | | | | | | ⊗ | | | ⊗ | | 5 |
| 16 | Segmentatize | | | | | | | | | | | | | | | | | | ⊗ | | | ⊗ | | ⊗ | ⊗ | | | | | | X | | | | 5 |
| 17 | Accurate | | ⊗ | ⊗ | | | ⊗ | | ⊗ | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 |
| 18 | Navigable | | | | | | | | | | X | | ⊗ | | | | | | | | ⊗ | | | | ⊗ | | | | | | | | | | | 4 |
| 19 | Flexible | | | | | | | | | | | | | ⊗ | | | | | | ⊗ | ⊗ | | | | | ⊗ | | | | | | | | | | 4 |
| 20 | Interactive | | | | ⊗ | | | | | ⊗ | | | | | | | ⊗ | | | ⊗ | | | | | | | | | | | | | | | | 4 |
| 21 | Narrated | | | | | | | | | | | | | | | | | | | | | | ⊗ | ⊗ | | | | | | | | X | ⊗ | | | 4 |
| 22 | Secure | | | | ⊗ | | | | | | | | | | | | | | ⊗ | | | ⊗ | | | | | | | | | | | | | 3 |
| 23 | Available | | | ⊗ | ⊗ | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | | | | | | 3 |
| 24 | Contextualized | | | | | | | | | | | | | | | | | ⊗ | | | ⊗ | | | | | | | | | | | X | | | 3 |
| 25 | Environment Friendly | | | | | | | | | | | | | | ⊗ | | | | | | | ⊗ | ⊗ | | | | | | | | | | | | | 3 |
| 26 | Multiplatform | | | | | | | X | | | | | | | | ⊗ | | | | | | ⊗ | | | | | | | | | | | | | | 3 |
| 27 | Original | | | ⊗ | | | | | | | | | | | | | | | | X | | X | | | | | | | | | | | | | | 3 |
| 28 | Reliable | | | | | X | | X | | | | | | | | ⊗ | | | | | | | | | | | | | | | | | | | | | 3 |
| 29 | Support Provided | | | | | | | | | | | | | | | | | | | | | ⊗ | ⊗ | | | | | | ⊗ | | | | | | | 3 |
| 30 | Visible | | | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | | | | | X | 3 |
| 31 | Connected | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | ⊗ | | | | | | | | | | 2 |
| 32 | InstructorCentered | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | ⊗ | | | | 2 |
| 33 | Sharable | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | ⊗ | | | 2 |
| 34 | Simplicity | | | | | ⊗ | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | 2 |
| 35 | Testable | | | | | | | ⊗ | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | 2 |
| 36 | Understandable | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | X | | 2 |
| 37 | Brainstormed / Storyboard | | | | | | | | | | | | | | | | | | ⊗ | | | ⊗ | | | | | | | | | | | | | | 2 |
| 38 | Analyzable | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | | | | 1 |
| 39 | Automated | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | 1 |
| 40 | Backup ready | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | | | | | | | 1 |
| 41 | Coding Effective | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 42 | Complete | | | | | | | | ⊗ | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 43 | Consumable | | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | 1 |
| 44 | Continous Improved | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | 1 |
| 45 | Feedback Diversity | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | 1 |
| 46 | Gamify | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | 1 |
| 47 | High Definition Video | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | | 1 |
| 48 | Incentivize | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | 1 |
| 49 | Mutual Assessable | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | 1 |
| 50 | Responsive | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | | | | | | 1 |
| 51 | Scalable | | | | | | | ⊗ | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 52 | Traceable | | | | | | | | ⊗ | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 53 | Translatable | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ⊗ | | | | | 1 |
| 54 | Video Engagement | | | | | | | | | | | | | ⊗ | | | | | | | | | | | | | | | | | | | | | | 1 |

Legend:
⊗ Factor share the same meaning and naming
X Factor share the same meaning
O Factor share the same naming

For the analysis facilitation as well as a better overview of the quality factors, any web application should be categorized into larger dimensions or characteristics [30], [39]. This technic can aid content providers to concentrate on a small number of categories instead of individual factors. To achieve this process, we examined the 7C's MOOC Course Development Framework [2]. From the extensive study on MOOC literature and content providers' testimony, the 7C's model categories are modified and customized to adjust the context of MOOC's development from the aspect of content provider as well as continuous learning. The four steps of PDCA model were adapted to place the role of continuous development which is missing on 7C's. We modified some of the stages like "do" to "develop", and "act" to "live" to give more reflection to the scope of this study.

The planning phase involves the analysis of preparation and requirements in order to set up the objective of the content created. Based on 7C's, there is a Conceptualized phase that insists on the essence of the content besides the preparation process to ensure the content is compatible with the MOOC environment and learner's expectation. MOOC only exists in massiveness and openness; we decided to put that two dimension as part of the core in the planning phase [49].

The development phase is leveled with the Activity phase in 7C's model. The capture phase refers to a resource audit that needs to be developed. As the video is a spine of the content, it is vital to ensure the quality factors are adapted in video development. The other phases like collaboration, communication and consider are meant to engage the learner with the instructor or platform consistently. Hence it

combined into a category named Engagement. The usability is much required to design and develop the contents to assure its learnability, convenience and practicality. Check phase leveled with Synthesis in 7C's which act as a revision stage and check for any error or failure before the content goes live. It involves improving and testing the content while comparing the results achieved with the content provider's expectation. Maintainability and portability [52] are two dimensions that play a vital role especially when involving internal quality factors. Finally, the Live phase assures the content is ready to be accessed by any MOOC users. Continuous improvement and maintenance will continue to run as well as the next step to inform the new cycle. We analyzed the definition of all the categories and factors as well as improve it. We consulted a dictionary and literature to clarify these definitions further, as detailed in the next section.

## III. Results and Discussion

### A. The review of possible quality factors

MOOC content quality factors were reviewed from 33 references consisted of two sets: Set1 is for web content quality (55 factors) and Set2 for online learning and MOOC content quality (140 factors).

### B. Combining the Factors

The total of 195 factors was combined based on the sharing process consisted of three possibilities: sharing the same meaning only, sharing the same name only and sharing the same name and meaning as practiced by [30]. For example, "novelty" and "originality" combine into "originality" since both have the same meaning. The combination is depicted in **Table 1**. This combining process leaves the remaining number of quality factors to only 54 as depicted in **Table 2.**

TABLE II
List of factors after combination process

| | | |
|---|---|---|
| Accessible | Navigable | Reliable |
| Secure | Ease of use | Responsive |
| Accurate | Environment-Friendly | Reusable |
| Adaptable | Feedback Diversity | Scalable |
| Analyzable | Flexible | Segmented |
| Automated | Gamified | Sharable |
| Available | High Definition Video | Simplicity |
| Backup ready | Incentivize | Structured |
| Changeable | Instructor-Centered | Visual Aesthetics |
| Coding Effective | Interactive | Support Provided |
| Complete | Legal Compliance | Testable |
| Comprehensive | Manageable | Traceable |
| Connected | Multiplatform | Translatable |
| Consistence | Mutual Assessable | Understandable |
| Consumable | Narrated | Viable |
| Contextualized | Original | Video Engagement |
| Continuous Improved | Personalization | Brainstormed / Storyboard |
| Currency | | |
| Readable | | Relevance |

TABLE III
Proposed category and quality factor of MOOC content along with its operational definition (OD)

| Categories (With OD) | Factors (With OD) |
|---|---|
| **Conceptual:** The vision, context, and preparedness of the content to assure its relevance to the learners. | **Relevance:** The content's objective, information, and the outcome are clear and relevant to the syllabus, learner's requirement and level of study. |
| | **Currency:** The content is accurate and up-to-date for learner's reference |
| | **Legal Compliance**: The content is in accordance of related policies and laws. |
| | **Original:** The content is developed by the authentic instructor or developer without alteration, deletion or corruption by any parties. |
| | **Storyboarded:** The content has clear storyboarded from the process of brainstorming. |
| | **Comprehensive:** The Content matches the learner's level of understanding, while covers topics in appropriate breadth and depth. |
| | **Structured:** The content is organized into a formatted organization, so it can be made addressable for more effective learning. |
| | **Accurate:** The content is trustworthiness, which is reputable, objective, cited and verifiable. |
| **Massiveness**: The content ability to handle an unlimited number of learners and their activities. | **Multi-Platform**: The content able to be run on various hardware and operating system. |
| | **Scalable**: The content able to handle unlimited and increasing access from learners. |
| | **Personalized:** The content able to provide relevant information based on learner's data which is gathered throughout the learning process. |
| | **Interactive:** The content capable to react with learners (through the button, animation, gamification) to increase its visibility and lessen the learner's effort to use it. |
| | **Automated:** The content can be evaluated and monitored automatically without constant supervision. |
| | **Accessible:** The content provides access to learners with different abilities. |
| **Openness:** The content enables unrestricted access to its information, as well as collaborative or cooperative among learner and instructors. | **Shareable**: The content able to be shared with other people or communities. |
| | **Reusable**: The content able to be moved or shared on the other platform. |
| | **Translatable**: The content able to be translated to another language, particularly understood by the learners |
| | **Connected:** The content allows collaboration between peers, instructors or other online communities to create an integrated whole |
| | **Feedback diversity:** The content allows feedback from various sources like peers, instructors, tutors or others. |
| | **Flexible:** The content allows adjustable access and less binding to the tight schedule or timing. |
| **Video Quality**: The Video content as the essential ingredient able to create continuous interactions between teachers and learners | **Segmented**: The video content able to be broken down into segments with an optimum length referring to learners' requirements. |
| | **Instructor-Centered:** The video contents place the instructor as major focus to catch the learner's attention. |
| | **Simple**: The video created with ease and simple features to be understood, without any abstraction. |
| | **High Definition**: The video has an optimum resolution to be watched conveniently by learners. |
| | **Narrated:** The video content progressing assisted by narration (voice) to assist learners keeping on track |
| **Usability:** The content's provides efficacy, efficiency and satisfaction to the learner in order to reach their objectives | **Navigable**: The structure of the content is designed to facilitate access and search of information, including clear linkages. |
| | **Readable**: The content is easy to be read and understood due to its clear text and information. |
| | **Understandable:** The content is easy to comprehend and learn |
| | **Visual Aesthetics:** The content color, style, harmony and consistency attract learners and place a higher reputation. |
| | **Consistency:** The contents have logical coherence, accordance, and uniformity among parts of it. |
| | **Responsive:** The content can successfully respond to the learner's input and behavior at any time, devices or locality. |
| **Engagement:** The content engages learners by providing activities prepared by instructor. | **Analyzable:** The exercise can be analyzed in terms of its access, popularity, and pattern. |
| | **Mutual Assessable:** The exercise allows assessment not only by the instructor by also peers. |
| | **Incentivize:** The content provides incentive elements on reading, access, collaboration, share etc. in order to enhance learner's motivation. |
| | **Gamified:** The content has elements of game playing like scoring, players competing etc. |
| | **Visible:** The content is easy to reached and accessed |
| **Maintainability:** the extent which content can be maintaining and cope with any possible failure and error during live process | **Changeable:** The content can be modified in stable conditions |
| | **Available:** The content can be accessed by learners of at least 99%. |
| | **Fault tolerance:** The content to able to continue functioning properly in the event of the failure of some of its features. |
| | **Reliable:** The content is trustworthy and consistency after executed. |
| | **Testable:** The content is capable to be tested in any context. If the testability level is high, the opportunity to find errors is also high. |

| | |
|---|---|
| | **Environmentally Friendly:** Development and usage of content emphasize on ecosystems such as printing and electricity reduction. |
| **Portability**: The extent to which content is capable to be transferred from development to live environment, considering learner's heavy usage and content massiveness. | **Coding Effectiveness:** The content is developed with structured and understandable programming, for any improvisation or modification. |
| | **Complete:** The ability of content to detect any incompleteness occurred from the development to the live environment. |
| | **Secure:** The content secured from unauthorized access, modification or any malicious threats. |
| | **Backup ready:** The content is developed with backup storage feature in the event of a data loss situation as well as system disaster |
| | **Adaptable:** The content can be adapted on different specified environment |
| **Continuity**: The extent to which content can be operated in the state of stability, without any interruption | **Consumable:** The content able to get significant access as it has useful information for learners. |
| | **Continuous Improvement:** The content able to be upgraded within an acceptable time for any improvisation without interrupting learner's access interruption. |
| | **Traceable:** The content can be can be analyzed to trace errors, bugs or malicious attacks. |
| | **Supportive:** The content has features that assist learners to get technical and instructional help. |

### *C. Categorization*

The 54 factors then assigned categories explained in the previous section. The categories and their factors are explained in **Table 3**. Some of the factors are modified to fit the environment of MOOC like "assessment" changed to "mutual assessment", since the assessment in MOOC can be executed bidirectional from the instructor and peers. Aesthetics modified to Visual Aesthetic because the attraction is through visual and more emphasis on reputational value. The definition for most factors is also adapted to the scope of MOOC content as in Figure 6.

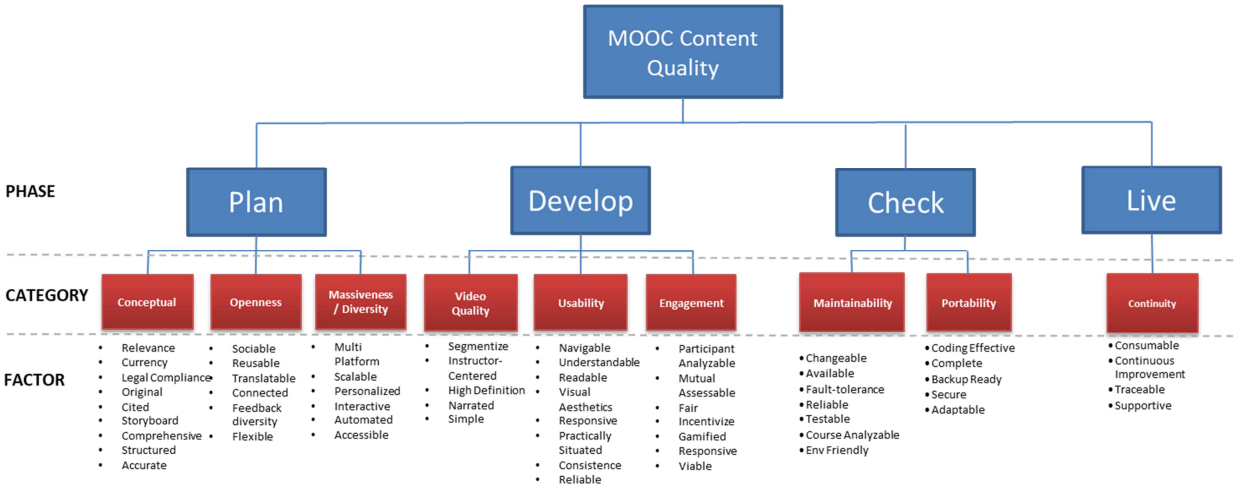


Fig. 6 The proposed Quality Model for MOOC Web Content

Fig. 6 portray the proposed model divided by the development phase which is the plan, development, check and live. Each phase consists of categories which described from the extensive literature review. Every category will be assigned with factors derived after the combination process. It needs to be validated by a group of experts through the process of acceptability measures in order to determine the accuracy and suitability of the quality factors, categories and dimensions.

## IV. CONCLUSION

This research proposed the quality model for MOOCs content which is first to be developed from the perspective of content providers. The model has been formed by consolidating quality factors from the relevant literature, consisting of e-Learning, MOOCs and other web applications quality model. We also studied previous benchmarks and frameworks in proposing the operational definition for every quality dimension and factors of MOOC content. The model will be the basis for supporting, validating, evaluating, controlling and guaranteeing the quality in creating and developing the MOOC content which is one the main reason for learner's retention. This proposed model is being developed comprehensively since it accompanied by operational definitions for each category and quality factor.

As the future works, the model will be validated by a group of content providers and experts through the process of content validity test and acceptability measures in order to determine the relevancy and acceptability of the quality factors, categories, and the definition from their perspective. Finally, we plan to develop a software or tool based on this model which allows stakeholders to evaluate MOOC's content quality level interactively. In line with MOOC's future development and acceptance, especially in the long-life learning and corporate training, this model can be used as a reference for content developers to produce high-quality content, as well as platform designs that suit the needs of learners. This research also aims to contribute to the body of knowledge related to the identification of the factors affecting MOOC content quality factors, and hopefully, able to provide significant input to a broader framework such as Quality Reference Framework (QRF) or other formal guidelines.

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