Journal of Theoretical and Applied Information Technology
30th April 2016. Vol.86. No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

THE IMPROVEMENT OF SOFTWARE QUALITY MODEL FOR ACADEMIC WEBSITES BASED ON MULTI-PERSPECTIVE APPROACH

[1]SUGIYANTO, [2]SITI ROCHIMAH, [3]SARWOSRI

[1]Department of Informatics, Adhi Tama Institute of Technology Surabaya, Indonesia

[2,3] Department of Informatics, Sepuluh Nopember Institute of Technology, Indonesia

E-mail: [1]sugiyanto.lecture@gmail.com, [2]siti@its-sby.edu, [3]sri@its-sby.edu

ABSTRACT

Evaluating the software quality requires a series of factors that will form the quality model. Most of the software quality models that already exist only provide the quality factor of software on generic domains. These conditions resulted in a software quality model on generic domains used to evaluate the academic websites quality. The software quality model on generic domains only provides a list of factors and subfactors quality without considering the needs and expectations of a particular user. In the academic website domain, each user has different needs and expectation, so there is a need to devise a model that is used to evaluate the quality of academic websites from the perspective of various user groups. This study proposes the improvement of software quality models for academic websites based on multi-perspective approach as follows prospective students, lecturers, and students. The improvement of software quality model is done using literature study, observation, interviews, questionnaire data processing, and giving priority weighting factor of the software quality. The result of the study is a new quality model that can be used to evaluate software on academic website domain from the perspective of prospective students, lecturers, and students.

Keywords: *Quality Models, Software Quality, Academic, Websites, Multi-perspective*

1. INTRODUCTION

Website development boomed in recent years. Each user can have different objectives in the use of such website to find information, communicate, send documents, e-learning, promote products, online shopping, and other [1]. Software developers need to develop a quality website to give satisfaction to users and maintaining a website so that users feel at home so that it can later be re-access the website again. The purpose of evaluating a website quality is to ascertain whether the website has been able to meet the goals expected by the user [2]. The evaluation results may assist software developers to understand the parts of a website that needs to be fixed.

Evaluating the quality of software requires a series of factors that will shape the quality model. Software quality evaluation model is expected to describe the characteristics of the software. Most of the website quality models that already exist only provide a website quality factors in the generic domains. Still a bit of quality evaluation model designed specifically to evaluate website in the particular domain such as e-book software [3], ERP systems [4], B2C e-commerce [5], B2B e-commerce [6], airline websites [7,8], e-learning [9], and academic websites [10,11,12]. These conditions resulted in a software quality model on general domains used to evaluate the academic websites quality. The software quality model on generic domains only provides a list of factors and subfactors quality without considering the needs and expectations of a particular user.

One-website domain used in the field of education is an academic website. Educational institutions use a website to provide information to the academic community, promote educational programs, published research/community service that has been performed, providing online learning facilities, and other [10]. Eldesouky et al. [10] using the framework Web-Sites Quality evaluation method (QEM) to create a framework of website quality evaluation model. Eldesouky et al. [10] propose five characteristics in assessing academic websites such as usability, functionality, content, reliability, and efficiency. Wang and Huang [11] evaluate Lund University website that focuses on

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

the main page and the page in English studies. Improvement of software quality models using the perspective of the user experience and the success of the website. The result of these studies is the quality factor framework consisting of the design, navigation, web technology, usability, functionality, content, and branding. Both of these studies still do not consider the user's perspective of the academic website.

Mebrate [12] have designed a framework for the academic websites quality evaluation based student perspective. The results of these studies are the quality of the assessment framework from the student perspective of an academic website that consists of quality factors such as usability, content, reliability, efficiency, and functionality. In the academic domain, there are three primary users of academic websites that have a different perspective, namely prospective students, lecturers, and students [12]. Each user has a need and different expectations. Therefore, evaluating the academic website quality need to take into account the needs of various groups of people. Thus, there is a need to design a new model that is used to evaluate the academic websites quality from the perspective of different user groups.

2. LITERATURE REVIEW

2.1. Software Quality

The software quality has become a major challenge since the start of the computer program. As a result, a large number of emerging software quality definitions, some have been standardized, but most of the definition of software quality is considered too vague and abstract. Needs and characteristics play a significant role in defining the quality. Therefore, an object-based model that is useful in better understanding of this issue. Software quality is defined as conformance to expect on all software built with an emphasis on functionality, performance, standards development and the characteristics that showed documented [13]. Software quality model is a simple representation of abstract and used to evaluate software quality.

Some organizations, such as ISO and IEEE, has been tried to make software quality standards by combining the model and associated characteristics and sub-characteristics of the quality model. Some studies also suggested as a software metrics tool to measure the program's source code, architecture, and performance of the software [14,15]. Until now, software quality assessment process remains an open problem with many models because it is not yet clear and the absence of a relationship agreement between the model of software quality and the relationship between the model and metrics.

The significant development in software engineering domain makes a focus of software quality evaluation shifted from the offline system to the online system. Some website quality model has been already existing e.g. Web-QEM (Web Quality Evaluation Model), 2QCV3Q-model (7 Loci), MiLE (Milano-Lugano), and MINERVA (Ministerial Network for Valorising Activities in Digitization). The weakness of some website quality model that already exists is still used general characteristic that cannot describe specific quality factors to evaluate particular software product or particular website domain.

2.2. Academic Website

The academic website is defined as a website that is used by an educational institution [16]. Different academic website with the website in a generic domain, such as an e-book software [3], ERP systems [4], B2C e-commerce [5], B2B e-commerce [6], and airline websites [7,8] because it serves the particular needs of specific users. The academic website should have a structure organizing information and content quality [17]. Academic website users are prospective students, lecturers, and students. They are looking for relevant information, reliable, and quality.

2.3. Multi-Perspective Approach

The fundamental purpose of academic institution creates a website is to promote academic and research education programs [18]. In the academic website domains, there are three primary users of academic websites that have a different perspective, namely prospective students, lecturers, and students. Each user has a need and different expectations. Therefore, evaluating the academic website quality need to take into account the needs of various groups. From the perspective of prospective students, academic institutions use the website to advertise their educational programs for prospective students who aspire to study in one of the fields of study offered campus. Information such as program entry requirements, application procedures, costs, individual contact information and important dates can be displayed on the website to facilitate communication academically information to students. Also, prospective students need information potential supervisor or promoter lecturer; research topics are offered, and areas of expertise of the prospective supervisor/promoter.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

From the perspective of lecturers, academic institutions use the website to disseminate outstanding achievement in research projects that have been completed, a change in the educational programs and the like to the public. The academic website needs to display information such as the information required by lecturer's research seminars, community service, and so forth. Also, the website also needs to display information academic research topics offered lectures to students. Research companies who are interested to cooperate with academic institutions can also get the accurate information they want from an academic website. From the perspective of a student, academic websites used to facilitate the learning process and provide information for student activities. To support the needs of the course material, students looking for lecture modules are uploaded to the academic website. Students are also seeking information prospectively lecturers, topics offered, and areas of expertise.

3. METHODOLOGY

This study uses 5-step construction of quality model, as follows:

1. Considering the existing quality models and choose the one quality model that will be used as a reference base. This study uses a model of an academic website quality from the student perspective [12] as a reference.
2. Identify the quality factor in the perspective of prospective students, lecturers, and students that can be added to the quality of the models. The identification is done by observation, interviews with the respondents (prospective students, lecturers, and students), and questionnaires completed by respondents.
3. Select the group that will give value to each current quality factor. This study chose a group of prospective students, lecturers, and students to provide value to the current quality factor to 14 academic websites as the research object.
4. Choose experts familiar with college website to assess the weight of each factor quality from the perspective of prospective students, lecturers, and students. Weight using expert assessment questionnaire. The expert survey contains a table of comparisons between the quality factor and sub-factor table relative importance of quality that will be used to obtain priority weight of each factor and the quality of the relative weighting of each subfactors quality college website. Giving weight values for each quality factor using Analytical Hierarchy Process (AHP).
5. Establish new quality models. Results of identifying the quality of the multi-perspective (step 2), and the weight of each quality factor assessment by the expert (step 4) will establish a new model of quality.

The test is done using a dataset of data in the form of a questionnaire to assess 14 academic websites. The questionnaire contains statements that will be used to get the value of each quality factor. Researchers deploy 45 questionnaires to prospective students (30 prospective students bachelor degree, ten prospective students master degree, five prospective students doctoral degree), 30 questionnaires to students, and 20 questionnaires to lectures. The sampling technique used by researchers is the method of non-probability sampling/non-random based goals (purposive sampling). Purposive sampling is a sampling technique with particular consideration. In this study, the sample data source, among others, prospective students, lecturers, and students in multiple programs of study were selected based on the assumption of understanding and expertise of the origin data. Academic websites as the research object in this study are 14 academic websites. A list of 14 academic websites as the research object in this study can be seen in Table 1.

Table 1: Research Object

Institute Name	Website URL
Gadjah Mada University	http://www.ugm.ac.id
Bandung Institute of Technology	http://www.itb.ac.id
Indonesia University	http://www.ui.ac.id
Airlangga University	http://www.unair.ac.id
Padjadjaran University	http://www.unpad.ac.id
Brawijaya University	http://www.ub.ac.id
Diponegoro University	http://www.undip.ac.id
Bogor Institute of Agrarian	http://www.ipb.ac.id
Sepuluh Nopember Institute of Technology	http://www.its.ac.id
Gunadarma University	http://www.gunadarma.ac.id
Indonesia Institute of Technology	http://www.iti.ac.id
Surapati University	http://www.surapati.ac.id
W R Supratman University	http://www.unipra.ac.id
Mayjen Sungkono University	http://unimas.ac.id

4. RESULT AND DISCUSSION

After the observation, interviews, and questionnaires, obtained four new quality factors that need to be added to the academic website quality model as follows visibility, presence, openness, and excellence. Those new quality factors are supported by previous studies [19], and the study has mapped the academic website in the

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world. Ortega and Aguillo [19] suggest the presence of other factors that can be used to distinguish the academic website quality. These factors are the activities of researchers and academic institutions in managing its website. Based on interviews of lecturers perspective, the factors related to the contribution of the academic website publishing activities in academic institutions is one of the duties of professors and academic institutions. This condition makes the quality factor should be added to the academic website quality model. Comparative evaluation framework of academic websites quality can be seen in Table 2.

Table 2: Comparative of Academic Websites Quality Model

Quality Factor	Sub-quality Factor	ISO 9126	Student Perspective [12]	Multi-perspective
Usability	Understandability	√	√	√
	Learnability	√	√	√
	Interactivity		√	√
	Operability	√	√	√
	Interface attractiveness	√	√	√
	Multiple language supports		√	√
Content	Relevance		√	√
	Accuracy		√	√
	Up to date information		√	√
	Authority		√	√
	Visibility			√
Reliability	Fault tolerance	√	√	√
	Recoverability	√	√	√
	Availability		√	√
Efficiency	Time behaviour	√	√	√
	Accessibility		√	√
Functionality	Navigation		√	√
	Search		√	√
	Suitability	√	√	√
Activity	Presence			√
	Openness			√
	Excellence			√

Usability is a combination of several design goals such as easy to learn, easy to remember, easy to understand, effective in its use, and easy to find information. Usability is divided into six quality subfactors as follows:

1. Understandability
   - A website must be created to help users easily understand how to use the website for specific tasks.
   - An organizing website, setting labels, links and terms utilized in the website must match the user's understanding of the site so as not to confuse users.
2. Learnability
   - Easy for users to learn how to use the website.
3. Interactivity
   - The website provides the facility for users to interact with the academic institution or a content writer in the website, such as providing an FAQ that summarizes answers frequently asked questions, and contact information as a facility for users to ask questions.
4. Operability
   - The website can be operated easily without making the user confused.
5. Interface attractiveness
   - Display the website should be attractive, and fun for the user to make an emotional appeal in using the website.
   - Choice of colors, name labels and font used should be consistent throughout the website.
   - A web page should not look overcrowded.
6. Multiple language supports
   - The website provides the facility to support multiple languages for international users.

Content is the information provided on the website. The information provided should be relevant, interesting, and according to user needs. Content is a major factor because the quality of the user comes to an academic website to search for specific information. Quality factor of the content is divided into six quality subfactors as follows:

1. Relevance
   - The information provided on the website is relevant and of interest to the user.

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- Information must be useful, comprehensive, precise oriented prospective students, lecturers, and students in the degree of completeness of the expected users.

2. Accuracy
   - Information on the website is not ambiguous and does not have grammar or spelling mistakes that may change the meaning of the information.
   - The academic information contained in the website may be academic, such as lecturer contact information, specific information about upcoming events, hours of university activities, and news about the university.
3. Up-to-date information
   - Website conveys the latest information related to the current situation at the university or institution (such as upcoming events, news, etc.).
   - The website displays the date when the updated content to help users know the time when the information was released.
4. Authority
   - The website shows information about the author is editing the substance of the pages within the website to enhance the credibility of the content.
   - The website was featuring references used from other sources outside of academic institutions by way of a quote or placing members a direct link to the reference.
5. Identity
   - Organization symbol (identity academic institutions) is available and clearly visible on every page.
   - The organization is responsible for all information posted on the website.
6. Visibility
   - The quality of the academic website content can be evaluated through the number of external links leading to an academic website. External links can be seen on search engines like Google, Yahoo, Bing Search, and so forth.
   - The link shows the prestige of the institution, academic performance, value information, impact and usefulness of the academic website. The more links, the greater the value of the academic website visibility.

Reliability relates to the performance of a website such as this website is available to the user and how the website's ability to recover quickly. Reliability quality factors are divided into three quality subfactors as follows:

1. Fault tolerance
   - The website must not have a dead link. Each link should work so that users can access all the web pages that you want to visit.
2. Recoverability
   - The website can recover to its previous state (normal) after an error occurs.
3. Availability
   - The website can be accessed at any time users. Percentage of time available to use the website ideally is 24 hours/day and 7 days/week.

Efficiency is the time required to perform the task of a website (throughput). The quality factor is divided into two quality subfactors as follows:

1. Time behaviour
   - The amount of time it takes a website to display a web page within 3-15 seconds.
2. Accessibility
   - The website is technically capable of supporting users who use different hardware (e.g. mobile phones, PDAs) to access the website.
   - The website avoids the use of plug-ins and software support that is not common.
   - The website supports multiple browsers and different screen settings.

Functionality is the ability of the website can perform the task according to the stated needs of the user. The quality factor functionality is divided into three quality subfactors as follows:

1. Navigation
   - The website provides a good navigation structure will help the users to browse the website to find the information they are looking without getting lost or frustrated.
   - The website provides links to return to the previous page, and home page.
2. Searching
   - The website provides a search feature that is available on every web page.
   - Users can customize the search according to the information users are looking for and scope of the website search options (such as courses, departments, lecturers, and faculty).
3. Suitability
   - Conformity website functions given to the user.

Activity is the contribution of the academic website publishing activities in academic institutions. The quality factor activity is divided into three quality subfactors as follows:

1. Presence
   - These web quality subfactors are assessing how many web pages (including all sub-domains and directories) from an academic website indexed by search engines like Google, Yahoo, Bing Search, and so forth.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

- The web page is assessed including all formats as static pages, dynamic pages, and files that exist in the academic website. The high value of presence indicates the contribution of all the people in the academic institutions in issuing millions of web pages.

2. Openness
   - The quality subfactors are assessing scientific document repository published in the academic website. Scientific papers can be published lectures, coursework, student research, faculty research, and so forth. Usually, these scientific papers affiliated with Google Scholar and Scopus.
3. Excellence

   These quality subfactors are assessing the advantages of an academic website. Academic papers published in national and international journals and indexed Scopus will help increase the value of the academic excellence of the website.

The next critical stage is the evaluation conducted by the researcher. The proposed model will be evaluated using the Metrics Evaluation Method [6]. This evaluation method allows a better understanding of the efficiency of the model in evaluating software products. This method explains that three criteria are owned by a good quality model, among others, comprehensiveness, understandability, and accuracy. The first criterion used to assess the quality of the models is comprehensiveness. This criterion states that a model of good quality will consider the different perspectives of stakeholders. As previously mentioned, the quality of the website is not the same college from various viewpoints of stakeholders, such as prospective students, lecturers, and students. To evaluate the success of the system, it is necessary to consider the satisfaction of all stakeholders. Here, the weight factor of the quality of the model determined by the perspective of prospective students, lecturers, and students who are stakeholders in the academic website. This allows a more accurate evaluation of the quality of the academic website. The results of this study shown that each quality factor has different weights according to the perspective of prospective students, lecturers, and students as shown in Table 3.

Table 3: The weight difference of the Quality Factor Different Perspectives

Quality Factor	Prospective Students	Lecturers	Students
Usability	0.12	0.07	0.11
Content	0.21	0.16	0.20
Reliability	0.08	0.25	0.07
Efficiency	0.34	0.38	0.27
Functionality	0.21	0.10	0.30
Activity	0.05	0.04	0.05
Usability	0.12	0.07	0.11

The results of this study showed that every quality subfactors have different weights according to the prospective students, lecturers, and students as shown in Table 4.

Table 4: The weight difference subfactors quality of different perspectives.

The Quality Subfactors	Prospective Students	Lecturers	Students
Understandability	0.023	0.012	0.016
Learnability	0.018	0.010	0.018
Interactivity	0.027	0.013	0.021
Operability	0.020	0.010	0.020
Interface attractiveness	0.010	0.008	0.018
Multiple language support	0.025	0.012	0.019
Relevance	0.058	0.039	0.047
Accuracy	0.016	0.029	0.033
Up to date information	0.039	0.016	0.039
Authority	0.031	0.037	0.031
Identity	0.037	0.021	0.027
Visibility	0.025	0.019	0.029
Fault tolerance	0.022	0.085	0.022
Recoverability	0.049	0.100	0.035
Availability	0.005	0.065	0.014
Time behaviour	0.153	0.156	0.109
Accessibility	0.187	0.224	0.157
Navigation	0.066	0.038	0.108
Search	0.064	0.033	0.078
Suitability	0.076	0.032	0.114
Presence	0.016	0.011	0.014
Openness	0.013	0.013	0.013
Excellence	0.020	0.020	0.020

The second criterion used to assess the quality of the models is understandability. According to this criterion, the structure and components of the model must be clear and unambiguous. The ambiguity in the model produces an incorrect interpretation of the relationship between the components of the model and the error in using the model to evaluate the software. As mentioned earlier, the quality of the model proposed in this study has used a hierarchical structure, the use of common expressions and titles, presenting a clear and accurate definition of the components of the model, and a one-to-many relationship between the various layers of the model. One example is the quality factor of usability that has a one-to-many to understandability, learnability, interactivity, operability, attractiveness interfaces, and multiple language support. Due to the structure of the proposed model focuses on a particular domain that academic website and is based on the model of the previous research, this model has a higher level of

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

clarity and easier to understand than the other models.

The third criterion used to assess the quality of the model is accuracy. This criterion states that a good quality model can be an assessment from the perspective of differences in ratings between stakeholders. The less difference in value will demonstrate the high accuracy of the model, given the difference between the weight value of the quality factor from the prospective students, lecturers, and students. The average difference is calculated by dividing the total difference in the value of the number of academic websites. The results showed that the average difference in the academic website quality assessment made using the previous model is 2.37. The results showed that the average difference in the quality assessment academic website made using the new model is 2.19. The average difference in the quality assessment academic website generated by the new model is smaller than the average difference in the quality assessment academic website produced by the old model. This suggests that the addition of new quality factors, among others, visibility, presence, openness, and excellence capable of increasing the accuracy of assessment of 0.18%.

The next process is to calculate the difference in the value of quality websites from the perspective of prospective students, lecturers, and students use the new model weights (proposed model). The old model produces an average difference of 2.37. The new model produces an average difference of 2.19. The model proposed (new model weighted) provides an average difference of 1.64. The difference between the proposed models with the old model is 0.73, so it can be concluded that the model generated in this study by 0.73% more accurate than the old model.

5. CONCLUSION

The model improvement carried out by adding a quality model quality factor visibility, presence, openness, and excellence in the quality of the old models and performs weighting of each quality factor there. The proposed quality model is 0.73% more accurate than the old models for assessing the quality of software quality in the academic website domain. This increase is caused by the addition of new quality factors such as visibility, presence, openness, and excellence as well as the difference in weight between the quality assessment from the perspective of prospective students, lecturers, and students. The weighting of software quality models were performed using Analytical Hierarchy Process (AHP) generates weighting factor that is hierarchical quality and consistent, the data obtained by distributed questionnaires filled out by experts who are specialists in the field of software quality management. Further research can be done by identifying other quality factors in the perspective of software developers that can be added to this quality model, for example, maintainability. Besides, future work can also be done by identifying whether the software quality factors interplay of factors other software quality in the academic website domain, for example, relationship functionality and efficiency, or usability and efficiency because it allows to have a negative correlation.

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