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## A Framework of Education Information Quality

### กรอบคุณภาพสารสนเทศด้านการศึกษา

#### Abstract

Information can be claimed to be an important aspect of any information system. Accurate information leads to better organizational administration and services. There are many quality features of desired information, provided by COBIT4.1., such as effectiveness, efficiency, confidentiality, integrity, availability, compliance, and reliability. The quality of education information must also conform to these criteria. Furthermore, the problems and causes of existing education information are illustrated. The construction of education information quality cannot be sound without stakeholders' participation, development methodology employment, information and communication technology usage, and environmental awareness. This paper therefore discusses this construction as a framework for sustainable education information development.

**Keywords:** education information quality, education information management, information quality framework

#### บทคัดย่อ

สารสนเทศเป็นองค์ประกอบสำคัญยิ่งส่วนหนึ่งของระบบสารสนเทศ สารสนเทศที่ดีสามารถนำไปสู่การบริหารจัดการองค์กรและบริการที่ดี โคบิต 4.1 ได้กล่าวถึงคุณลักษณะของคุณภาพสารสนเทศที่พึงประสงค์ ซึ่งประกอบด้วย ประสิทธิภาพ ประสิทธิผล การรักษาความลับ บูรณภาพ สภาพความพร้อมใช้งาน ความสอดคล้องกับกฎเกณฑ์ และความเชื่อถือได้ ดังนั้นสารสนเทศด้านการศึกษาก็ควรมีคุณลักษณะของคุณภาพสารสนเทศดังกล่าว งานวิจัยนี้แสดงถึงปัญหาและสาเหตุของปัญหาของสารสนเทศด้านการศึกษา การพัฒนาคุณภาพของสารสนเทศด้านการศึกษามีผลกระทบบ้างได้โดยอาศัยความร่วมมือของผู้มีส่วนเกี่ยวข้อง การใช้ระเบียบวิธีในการพัฒนา การใช้เทคโนโลยีสารสนเทศและการสื่อสาร รวมไปถึงความตระหนักถึงสภาพแวดล้อมที่เกี่ยวข้องเพื่อสนับสนุนการพัฒนา เพื่อเป็นที่มาของการสร้างกรอบแนวคิดในการพัฒนาคุณภาพสารสนเทศด้านการศึกษายิ่งขึ้น

**คำสำคัญ:** คุณภาพสารสนเทศด้านการศึกษา, การจัดการสารสนเทศด้านการศึกษา, กรอบคุณภาพสารสนเทศ

#### 1. Importance of Information Quality for Education Management

Education is the system of teaching people, or the gradual process by which a person gains knowledge and understanding through learning

(Collins, 1987). Educated and ethical people are a key resource in a country's development. The objective of most educational institutions is therefore to promote this human resource development. Education management requires the

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skills and knowledge of educational leadership, to achieve the institute's objectives. To attain such an objective, information is a main asset. Information leads to better education administration and services. The examples of related education information are education services, curriculum, research and development, social services, lecturer and staff, student, finance, and education resources, etc. Such information is a primary source for promoting education opportunity, education control and assessment, and education quality assurance.

Most educational institutions, including universities, face the problems of information shortage, getting reliable. It is information, and time-consuming to compile reliable information. Even though, many institutes make a huge investment in developing education information systems; the consolidation and improvement of this educational information are still key requirement. This paper aim therefore to analyze the problems and causes of educational quality, review information quality, and suggest the framework of educational information quality development. It is important to note that a collaborative work is necessary to develop this information quality, which is in turn used to improve the services. The success of providing quality education information and service is to ensure that educational staffs and students receive appropriate information and services, which is essential in maintaining each stake holder's satisfaction and the institute's revenue.

## 2. Literature Review

DeLone and McLean introduced the model of information system (IS) success, which contains system quality, information quality, and service quality. IS quality can affect the actual use, user satisfaction and have, an individual and organizational impact (DeLone & McLean, 2003); (Livari, 2005) Perceived IS quality is a significant predictor of user satisfaction with the system and usage (Livari, 2005); (Wangpipatwong & Chutimasku I, 2005). Many standards have therefore been developed for supporting the IS quality. Considering only Information quality, it is a multidimensional concept Wand & Wang (1996, pp. 86-95); Naumann (2002, pp. 29-50); Pipino, Lee & Wang (2002, pp. 210-218) The pioneer list of information quality dimensions is given by Wang, who is the Director of the Massachusetts Institute of Technology Information Quality Program. Since late 1990, he and his colleagues have written several papers Pipino, Lee & Wang (2002, pp. 210-218); Wang & Strong (1996); Strong, Lee, & Wang (1997, pp. 103-110); Kahn, Strong & Wang (2002, pp. 184-192); Lee et.al. (2002, pp. 133-146) based on the sixteen information quality dimensions i.e. accessibility, accuracy, amount of information, believability, completeness, concise representation, consistent representation, ease of manipulation, interpretability, objectivity, relevancy, reputation, security, timeliness, understandability, and value-added. These information quality dimensions can be classified into four categories: intrinsic, accessibility, contextual, and representational, see Table 1.



Table 1 Information Quality Dimensions

Information Quality Categories	Dimensions
1. Intrinsic	Accuracy, Believability, Objectivity, Reputation
2. Accessibility	Accessibility, Security
3. Contextual	Amount of Information, Completeness, Relevancy, Timeliness, Value-added
4. Representational	Concise representation, Consistent representation, Ease of manipulation, Interpretability, Understandability

*Note.* From “Data Quality in Context,” (p. 104), by Strong, D. M. Lee, Y. W., & Wang, R. Y., 1997, *Communications of the ACM*.

The above information quality dimensions are employed in many fields, e.g. website information quality Katerattanakul & Siau (1999, pp. 279-275), and “SiteQual”, which is an overall quality of B2C (business-to-customer) electronic commerce websites Webb & Webb (2004, pp. 430-440). For professional information quality, COBIT (Control Objectives for Information and Related Technology) 4.1, which is an internationally accepted IT governance framework, is widely used as an international standard. COBIT 4.1 gives overall seven information quality criteria: effectiveness, efficiency, confidentiality, integrity, availability, compliance, and reliability IT Governance Institute (2007) However, it does not give a concise definition for each criterion. More details will be analyzed in section 4.

### 3. Problems and Causes of Existing Education Information

The key problem of existing education information is that it is unable to ensure objectivity, utility and integrity. This problem is highlighted in “the guidelines for ensuring and maximizing information quality disseminated by Federal Agencies” Office of Management and Budget (2002) The objectivity includes accuracy, reliability, lack of bias, clarity. The utility can be viewed as usefulness. Finally, integrity is defined as an information security. These educational information problems are shown in Table 2. Most educational institutions cannot provide the total information quality explained above. Therefore, the educational administrator should understand the types of educational information needed for educational management, examine the organizational information problems and their causes, and give guidelines on desirable educational information quality to their information development staffs.



Table 2 Problems of Education Information

Problem	Information Quality Dimensions
1. Lack of Objectivity	Inaccuracy
	Unreliability, Unbelievability
	Biased
	Blur & Poor Interpretability
	Incompleteness
2. Poor Utility	Useless & Non Value-added
3. Poor Integrity	Insecurity

After analyzing the factors of the above problems, there are four main causes: stakeholders, methodology, ICT, and business environment. People do not totally understand the information management required for education. Poor methodology is used in managing information during information construction and maintenance. ICT is misused or unutilized to gain high benefits from investment. Finally, the business environment is unaware of information standards, formats, and language for difference international communication, etc.

Due to the lack of information quality, it is difficult to gain the competitive advantages by the advent of next-generation education information service. It is inevitable that information cannot support business strategy. Therefore, education information can be a source of an on-going problem of declining revenues, and increasing pressure to roll out new education services and curricula. Educational information is a way of rethinking this educational business model and altering the way it operates. Hence, it is used to

improve education experience, by having now and new generation of education information quality.

#### 4. Educational Information Quality

Information quality is a multidimensional concept (Wand and Wang 1996, pp. 86-95); Naumann (2002, pp. 29-50); Pipino, Lee and Wang (2002, pp. 210-218). In different contexts, the primary information quality dimensions to be considered will be different. The educational information discussed in this paper is the information provided electronically by applications of IT. Therefore, in order to determine their quality dimensions, an internationally accepted IT governance framework: COBIT 4.1 (Control Objectives for Information and Related Technology) is used. COBIT 4.1 includes a brief section, mentioning seven overlapping information criteria: Effectiveness, Efficiency, Confidentiality, Integrity, Availability, Compliance, and Reliability IT Governance Institute (2007). Thus, the education information should possess the following characteristics:



- *Effectiveness*: Education information should be relevant to education services, i.e. providing the useful and valuable content that is needed in education services. Furthermore, it should be sufficiently up-to-date. As a criterion, according to COBIT 4.1, effectiveness also include an appropriate format and representation, meaning that the education information should be usable and it should be provided in a consistent and concise format. In other words, effectiveness in COBIT 4.1 includes *value, timeliness, format, and understandability*.

- *Efficiency*: Education information should be provided by the optimal use of resources. This also implies the *interoperability and maintainability* of the information. The information should be easily shared, manipulated, and maintained to minimize the cost and resources.

- *Confidentiality*: Access to information should be carefully restricted to maintain its *security*. As education information can include staff's and students' personal information, their *privacy* should also be protected.

- *Integrity*: The *accuracy and completeness* of education information should be considered. Education information should be unbiased, correct, accurate and complete. It should not be missing. It

should have sufficient breadth and depth for the task.

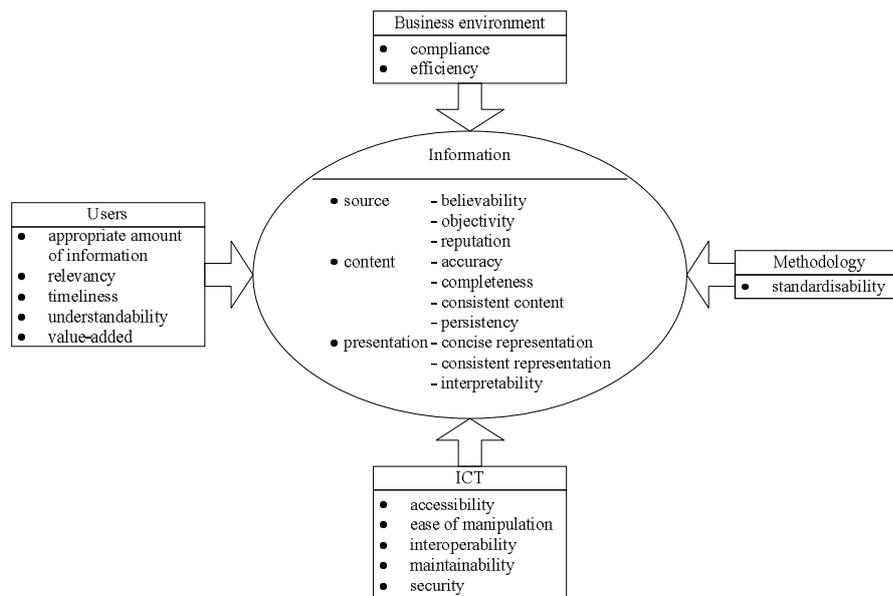
- *Availability*: The information should be accessible and available when needed. Educational information should be information-on-demand through automation.

- *Compliance*: The education information should comply with external criteria, such as laws and regulations, as well as internal policies.

- *Reliability*: Users should be able to access relevant information that is true and credible, whenever they need it.

## 5. A Framework of Education Information Quality Development

A framework is a particular set of rules, ideas, or beliefs which may be used to deal with problems or to decide what to do Collins (1987). The framework of education information quality is a particular set of quality rules and dimensions that can be considered for building educational information quality. The absence of any part of these dimensions will reduce the quality of education information. Therefore, this framework provides the minimum requirements for an educational administrator to develop education information quality, (see Figure 1).



**Figure 1 A Framework of Education Information Quality Development**

Figure 1 clearly shows that educational information quality cannot be considered solely from the “Information” perspective. It should be considered from the other four perspectives as well. The details of this framework are explained below.

- **Information:** educational information quality dimensions involve the education information content, its source, and its presentation. The dimensions in this group are: believability, objectivity, reputation, accuracy, completeness, consistent content, concise representation, consistent representation, and interpretability. Educational content management is also very important; however, it is beyond the scope of this work.

- **Users:** The users of educational development are educational administrator, lecturers, staffs, and students. Each user has a variety of duties and responsibilities depending on his/her role, especially the leadership. Each user must fully participate in developing information

quality. This aspect can be classified as the quality metrics of organization and human factors containing stakeholder knowledge and skill, participation (e.g. requirement elicitation and acceptance), and ethics Sayana (2002). Educational partnerships are also important in educational business collaboration. Furthermore, information strategy and policy must be carefully considered. The dimensions in this group are appropriate amounts of information, relevancy, timeliness, understandability, and value-added.

- **Methodology:** This concerns the activities of wisely investigating and developing education information. There are two aspects which are explained below.

- **Information process management.** It must consider the familiarity of used technology, the necessity of adjustment to various parties, the requirement management, the complexity of system features, the difficulty of integration of commercial off-the-shelf software (COTS), the performance



requirement, the hardware constraints, the experience of the platform, the stability of platform, the amount of documentation, the design considerations of reliability-safety-security, and the risks of used tools Abe et. al. (2006).

- Information project management. It must consider project planning, the test environment, the size and the cost estimation, the availability of system and support, and the communication among project stakeholders. The project management standard introduced by COSO and COBIT 4.1, includes control activity, risk assessment, and process monitoring IT Governance Institute (2007); The Committee of Sponsoring Organizations of the Treadway Commission (2006), while the PRINCE2 standard specifies the methods to efficiently manage and control projects, so that the project's objectives can be achieved. The PRINCE2 standard is composed of eight processes: starting, planning, initiating, directing, managing, controlling, delivering, and closing Office of Government Commerce (2006).

- The informational quality dimensions is associated with the construction or delivery of educational information. This dimension concerns the standardization of process management and

projects the management of construction education information.

- ICT: ICT enables users to participate in the educational administration and services anywhere and at any time. This makes education more convenient to use. Some examples of ICTs for education are Internet technology, mobile and wireless technology, collaboration technology, and enterprise application. The competence and robustness of ICT for managing education information must be carefully analyzed and used. The continuous support by ICT vendors and ICT staff is also necessary. In addition, this information quality aspect involves system infrastructure and tools. The dimensions in this group are accessibility, ease of manipulation, and security. Accurate information requires reliable data storage, data management, and data communication.

- Business Environment: The information quality dimensions in this group are related to the business context of the information. They are compliance and efficiency. The definition of each information quality dimension, which is grouped by COBIT4.1 standard, is given in Table 3 Chongsuphajaisiddhi (2007)

**Table 3 Information quality dimensions and definitions**

Dimension	Definition
<b>1 Effectiveness</b>	
Concise representation	The extent to which information is compactly represented.
Consistent content	The extent to which information is similar to other sources.
Consistent representation	The extent to which information is presented in the same format.
Interpretability	The extent to which information is in appropriate languages, symbols, and units, and the definitions are clear.
Timeliness	The extent to which information is sufficiently up-to-date for the task at hand.
Understandability	The extent to which information is easily comprehended.
Value-added	The extent to which information is beneficial and provides advantages from its use.
<b>2 Efficiency</b>	
Efficiency	The extent to which information is provided through the optimal use of resources.
Appropriate amount of information	The extent to which the volume of information is appropriate for the task at hand.
Ease of manipulation	The extent to which information is easy to manipulate and apply to different tasks.
Interoperability	The extent to which information can be shared among various users.
Maintainability	The extent to which information is easy to update and extend.
<b>3 Confidentiality</b>	
Security	The extent to which access to information is restricted appropriately to maintain its security and privacy.
<b>4 Integrity</b>	
Accuracy	The extent to which information is correct and reliable.
Completeness	The extent to which information is not missing and is of sufficient breadth and depth for the task at hand.
Objectivity	The extent to which information is unbiased, unprejudiced, and impartial.
<b>5 Availability</b>	
Accessibility	The extent to which information is available, or easily and quickly retrievable.
<b>6 Compliance</b>	
Compliance	The extent to which information is compliant with externally imposed business criteria, e.g. laws and regulations; as well as internal policies.
Standardisability	The extent to which information life-cycle is governed by a standardised process.
<b>7 Reliability</b>	
Believability	The extent to which information is regarded as true and credible.
Persistency	The extent to which information remains existing.
Relevancy	The extent to which information is applicable and helpful for the task at hand.
Reputation	The extent to which information is highly regarded in terms of its source or content.

*Note.* From “Data Quality in Context,” (p. 212), by Strong, D. M., Lee, Y. W., & Wang, R. Y., 1997, *Communications of the ACM*.



The quality of education information must be high enough to support better educational administration and services to meet the staffs and students' requirements, by the use of information and communication technology (ICT). It is important for persuading educationalists to use the system. One of the education success factors can be assessed by measuring its information quality.

### 5.1 Empirical Test of Education Information Quality: Users' View

The test of educational information quality depends upon the co-operation education staffs and students since they are the main participants in the education activities ISO (1999). To test whether or not the proposed characteristics of education information quality is workable, an empirical survey should be conducted. The education information quality has been surveyed by using

online questionnaires. The 140 citizens who have experience in education activities are the sample sizes of this survey. The key characteristics of information quality are interpreted at five levels: most important, very important, neutrally important, less important, and least important. The result of this survey of information quality is shown in Table 4. Users in this survey thought that all of the seven information quality characteristics are important (most important or very important). The most important characteristics are confidentiality, integrity, compliance, availability, and effectiveness, respectively. The very important characteristics are reliability and efficiency. It can be then conducted from this survey that users need their information to be secure and private. Therefore, education information quality should be considered by an education steering committee for developing accurate information.

Table 4 Characteristics of Education Information Quality

Information Quality Characteristics	Mean	SD	Interpretation
1 Confidentiality	4.56	0.64	Most Important
2 Integrity	4.54	0.60	Most Important
3 Compliance	4.32	0.74	Most Important
4 Availability	4.29	0.65	Most Important
5 Effectiveness	4.22	0.71	Most Important
6 Reliability	4.06	0.74	Very Important
7 Efficiency	4.06	0.74	Very Important



## 6. Summary

This paper addresses the importance of educational information quality for underpinning educational administration and services. Most education information system developments pay a great deal of attention to hardware and software, with less attention to prod information. The problems and causes of information quality are discussed. Seven characteristics of education quality applied from COBIT4.1 are also illustrated. To provide the success of education information development, the framework of education information quality development is introduced. It contains five aspects: information, education people, methodology, ICT, and business environment. Considering all these aspects can support sustainable education information quality development. Most educational corporate strategy is to build “education information hubs” as their corporate brain. This can be achieved by people-process-information integration. ICT, such as collaborative tools, robust data storage, and mobile

technology is to provide dynamic educational management capability. A business environment is to support global education management. Thus, the success of education management requires the quality of education information, which is a competitive strategy to provide lower prices for an education service and high revenue.

### 6.1 Future Work

To complete the model of education framework which is beyond the information quality, process quality and service quality should be considered. This leads to a model of education system success, which can be modified from DeLone-McLean model of information system success. The proposed education success is shown in Figure 2. The education system quality contains process quality, information quality, and service quality, which promote actual use and user satisfaction. Both then promote individual impact, and organizational impact, respectively.

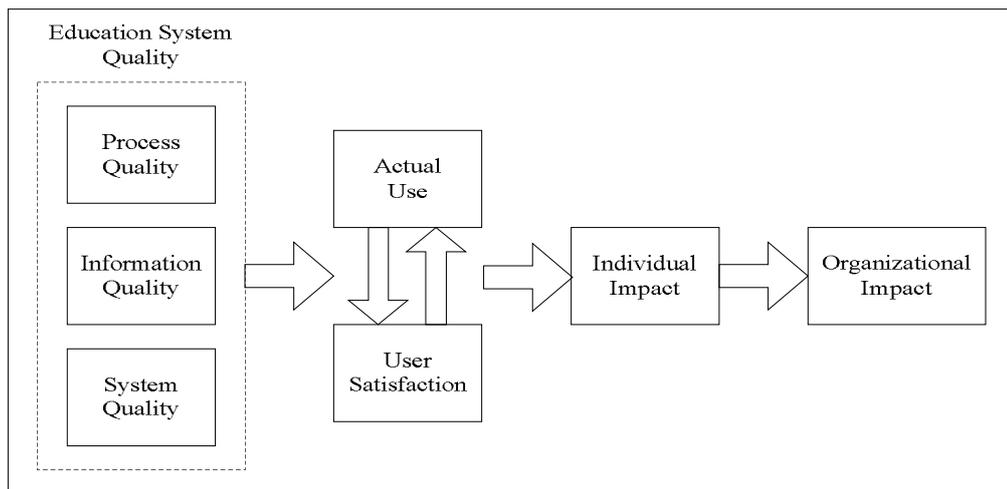


Figure 2 A Model of Educational System Success, based on the DeLone and McLean Model

Note. From "The DeLone and McLean Model of Information Systems Success: A Ten-Year Update," (pp. 9-30), by DeLone, W. H. & McLean, E. R. (2003). *Journal of Management Information Systems.*, Vol. 19, (4).



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