Development of an Extended Information Quality Framework for E-Learning System Content for Engineering Education Courses (EECs)

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Abstract

Poor integration of pedagogical and technological learning elements within teaching and learning methodologies may have substantial impacts on the effectiveness of learning. Although educational institutions are improving their courses, teaching and learning methodologies and assessment strategies with tailored approaches, their efforts at improvement tend to focus narrowly on academic results. The authors believe that educational courses should give priority to educational goals and labour market expectations (industrial companies' requirements) in devising the methodology of teaching and learning. The technology based learning system has a capability to comply with diverse requirements as mentioned above. The purpose of this paper is to develop an extended information quality framework to measure the effectiveness of e-learning content for technology based learning system for engineering education courses (EECs) in Technical and Vocational Education (TVE) in Bahrain. The model incorporates the requirements of educational goals (TVE goals) and modern industrial needs and integrates these with existing information quality frameworks. The extended model incorporates pedagogical and technological elements, is consistent with the educational objectives and industrial requirements, and can be used as guidelines for measuring the effectiveness of e-learning packages delivered in EECs.

Key words: engineering education courses (EECs), Technical and Vocational Education (TVE), information quality framework, modern industrial requirements.

1- Introduction

The authors have been researching the effectiveness of EECs in TVE system in Bahrain in meeting the requirements of educational and industrial stake holders. A strength and weakness analysis of the existing provisions indicated that TVE in Bahrain is facing a number of operational challenges that are linked to the delivery of appropriate courses and training sessions and the development of appropriate skills required by modern industry (Alseddiqi et al., 2010). A work preparation skills model was proposed for improving knowledge, attitude, and technical proficiencies. The model provides a developmental structure to the content of EECs to meet modern industrial requirements and hence close/minimise the identified skills gap (Mishra et al., 2009). In parallel, TVE is employing information and communication technology (ICT) in teaching and learning processes. The aim is to convert the Bahraini society and economy into a technological society and knowledge-based economy. The rationale behind using technology in pedagogical practices is that it could be a feasible solution to meet the needs of industry as well as improving general education outcomes. Development of an effective e-learning package may contribute to close/minimise the identified work preparation skills gap. This paper describes the

development of an extended information quality framework to ensure quality compliance. The model could be used to evaluate the effectiveness of e-learning systems in EECs. The next section of this paper presents educational and industrial needs requirements that an e-learning system must satisfy.

2- Modern Industrial needs from TVE Systems

The importance of integrating industrial needs within the TVE has been extensively reported in the literature. Educators agree that the most important issue is to integrate appropriate skills in curricula development, including different knowledge, attitude, and practical skills. Brown (2002) indicated that students should learn how employability skills are practised in the real workplace and demonstrated across a variety of settings. In the learning process, employability skills were not an exception (Brown, 2002); students gain knowledge skills in the classroom environment and practise specific skills in practical workshops. It was worth mentioning that teachers have become master practitioners to help students in the learning process and adapt their teaching style according to students' needs.

The Economic Development Board (EDB) and the TVE system in Bahrain conducted a benchmark study of the existing educational systems (TVE Directorate, 2006). The study found that significant demand existed for vocational skills in Bahrain's labour market, which should be integrated effectively in the learning process. The study compared three educational systems in order to propose the one most suitable educational TVE for Bahrain, as shown in figure 1.

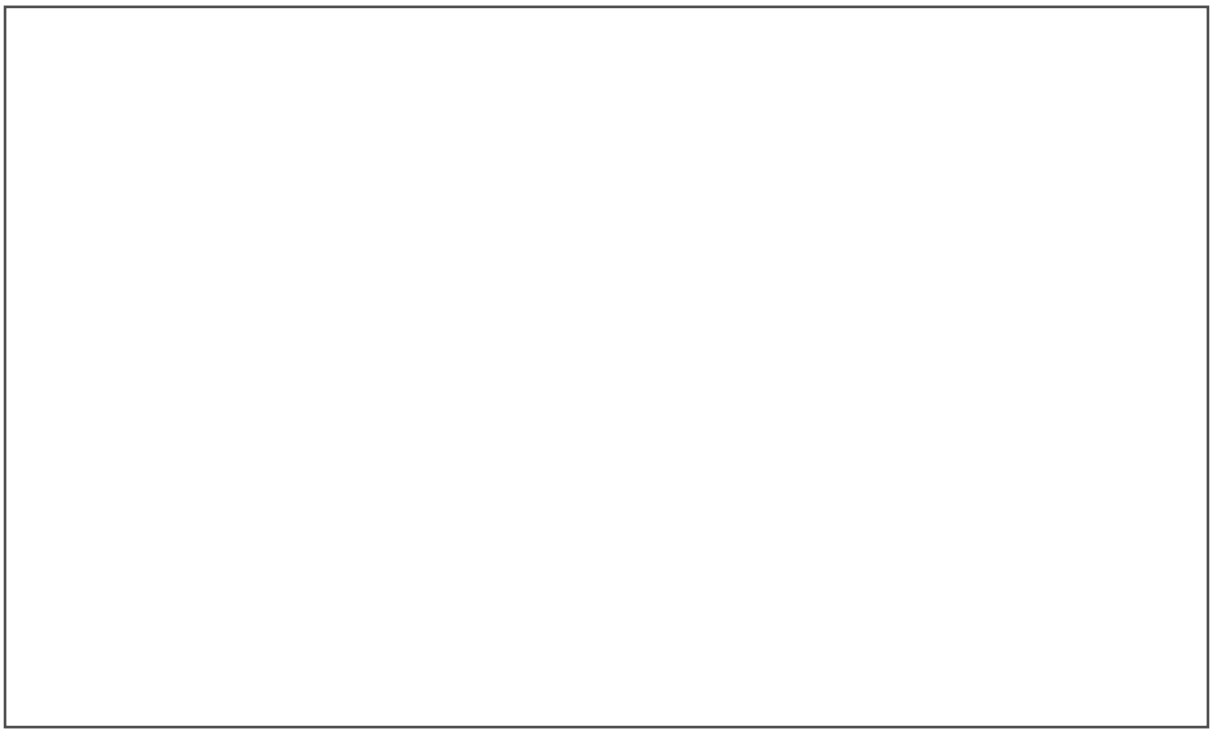


Figure 1: Comparison of three TVE systems (TVE Directorate, 2006)

Even though the existing educational system (dual) has it strengths and weaknesses, the study highlighted the important issues to be considered in a TVE system. Figure 2 shows the expected modern industrial needs from the existing TVE system and what the new system may offer to improve the standard of employability skills required by the industry to be integrated into EECs.

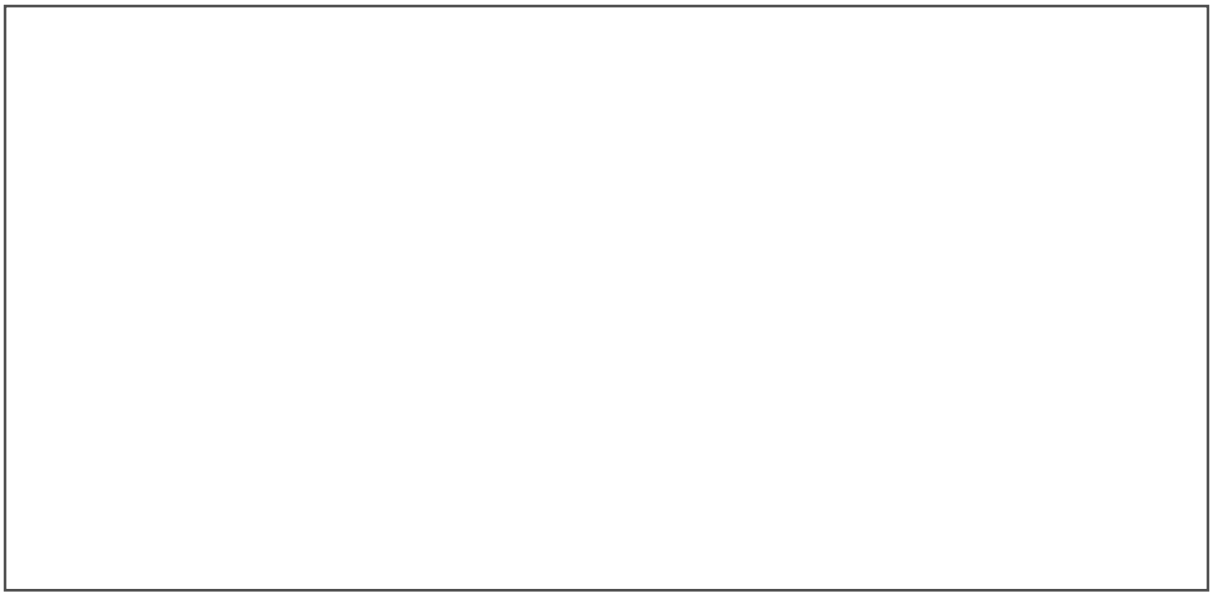


Figure 2: The modern industrial needs (TVE Directorate, 2006)

The QAAET report (2011) confirms the areas of main strengths and areas for development in the TVE system in Bahrain. The main strengths were in the following areas:

- Specific technical skills taught during vocational and practical modules.
- Health and safety procedures in the practical workshops.

However, the areas for development included the following:

- Soft skills in Arabic, English and mathematics.
- Students' performance and involvement in theoretical modules.
- Students' motivation, self-confidence, and analytical thinking skills.
- Teaching and learning strategies, specifically considering individual differences in theoretical modules.
- Extra-curricular activities and training programmes to respond to industrial requirements.

To conclude, the modern industrial needs can be categorised into three dimensions, namely knowledge proficiencies, personal attributes, and specific technical skills. In addition, the extensive review of literature has indicated that the modern industrial requirements from employability skills components could be categorised using various learning elements from Bloom's taxonomy (Anderson and Krathwohl, 2001). The authors suggested using Bloom's taxonomy to structure the content of EECs in TVE systems.

The next section discusses the integration of technological aspects in the TVE system in Bahrain and its influence in improving EECs in TVE as well as delivering EECs in e-learning environments.

3- E-Learning in the TVE System

The rationale behind using technology in pedagogical practices was that it could be a feasible solution to meet the needs of industry as well as improve general education outcomes. Development of an effective virtual learning environment (e-learning package) may contribute to

closing/minimising the identified employability skills gap.

In the mid-1980s, the concept of information technology was introduced in secondary schools in Bahrain. In order to employ information technology throughout the learning process, the Ministry of Education (MoE) provided computer laboratories in general schools as well as in TVE schools. More recently, learning resource centres have been initiated in various schools, with personal computers linked to the World Wide Web (MoE, 2011). In parallel to this, in-house training was delivered to TVE members including teachers, specialists, and administrators. The purpose was to assist them in using information technology in the process of learning and to achieve the educational goals.

During the last decade, a new project entitled 'King Hamad's School of the Future Project' was established aiming to (MoE, 2011):

- Make a quantum leap in the outcome of process of education in the Kingdom of Bahrain.
- Meet the immediate needs of national development and modern industrial needs
- Invest in ICT to achieve efficiencies in curriculum subjects at all stages of education.
- Develop an e-learning culture in schools.
- Provide students with the values and skills necessary for the information society and knowledge economy.
- Develop curricula for various subjects gradually.
- Deliver teachers' training and students' training in the use of e-learning systems.

By achieving the above, technology will introduce a new culture to learning in TVE. For example, theoretical and practical modules may be integrated and presented in a manner which motivates TVE students. Therefore, the e-learning content for theoretical EECs should contain videos, links, animations, emotions, graphs, and numerical representations as well as demonstration of employability skills that should be performed during practical modules in laboratories and/or workshops. Therefore, the TVE curriculum should be adapted to meet the needs of technology integration in the learning process and hence modern industrial requirements. The curriculum content should also be improved to support the Internet, interactive multimedia, and software in order to develop TVE students' self-learning skills.

TVE specialists were aware that the TVE curriculum content, teaching and learning methodologies and assessment strategies must be evaluated and adapted to support the integration of technology in the learning process. Recently, the EECs in TVE have gradually improved using technology and are taking steps to implement the following:

- Adapt the learning resources/materials based on local needs from industry. However, national and international industries should be considered as well.

- Consider the modern needs for employability skills. For example, in a 2005 survey by MoE, it was indicated that work ethics skills, cultural awareness and language skills were considered important by the local industries in Bahrain, and should be vital aspects in designing the curriculum.

It was obvious that significant attention was given at improving the EECs in TVE and to integrating the appropriate technology in order to meet modern industrial needs. Even though the development process is still under way and some pilot studies have been implemented, it is worth mentioning that a quality framework should be developed. The purpose is to evaluate the effectiveness of the EECs with respect to two main aspects: the pedagogical and the technological. This will help to improve the existing EECs on a continuous basis. The next

section therefore reviews the available literature on information/data quality frameworks for e-learning system content.

4- Existing information quality frameworks

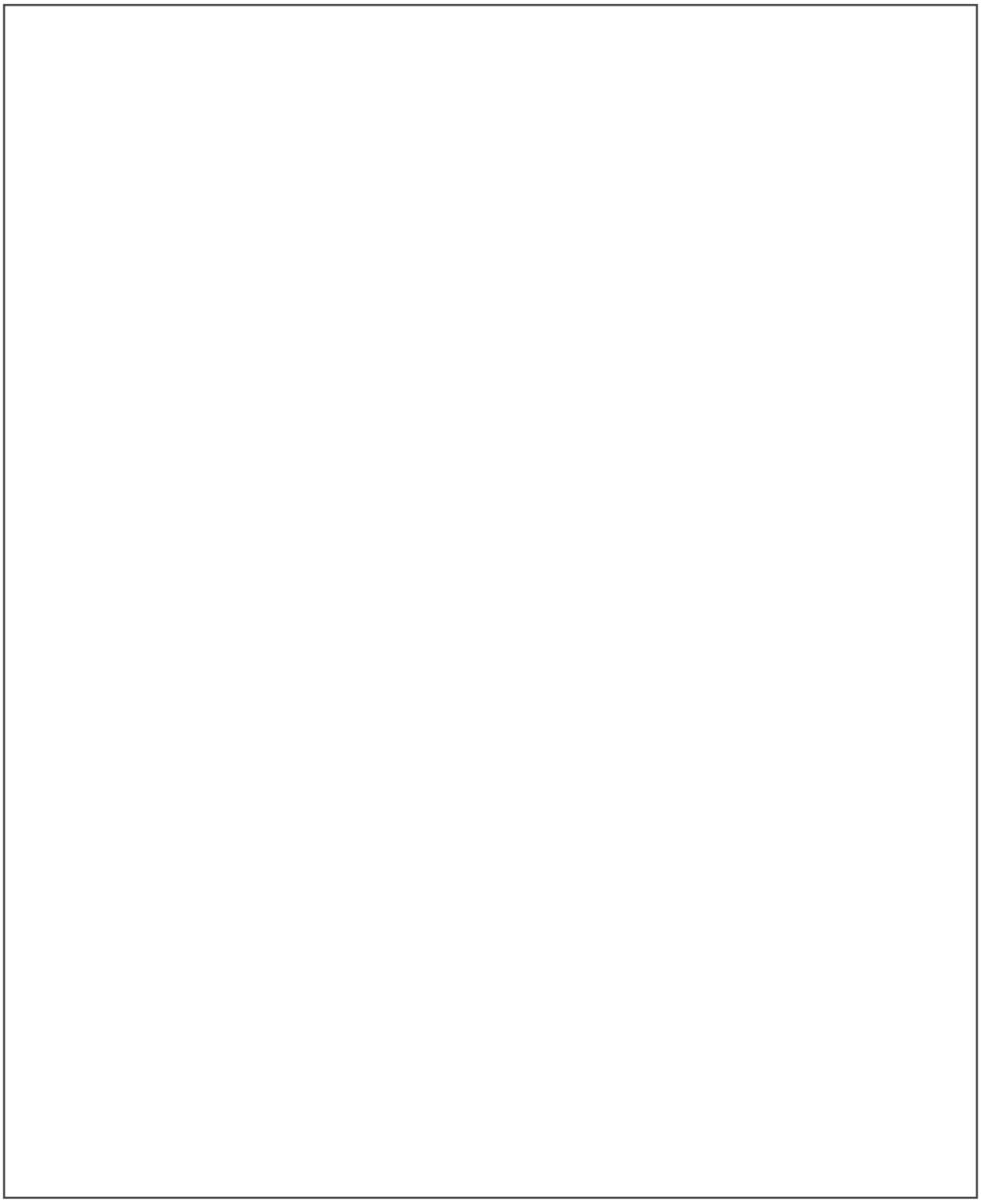
Various publications have indicated that the development of an e-learning system has three fundamental aspects, namely institutional, pedagogical, and technological. In reality, these three aspects include user analysis, knowledge/information analysis and communication, pedagogical and technological structures, pedagogical and technological representations, and interface and navigation design. The objective is to provide an intelligent e-learning system so that students will have access to learning case studies and be tested in ways that best match their educational needs and requirements. It was obvious that most of the work was concentrated on developing an effective learning curriculum, using different teaching and learning methodologies and up-to-date information technology. In addition, Richard Wang and Diana Strong in 1996 (Wang and Strong, 1996) initiated original work for setting standards for data/information quality frameworks. Their purpose was to critically evaluate users' viewpoints towards the content of e-learning systems and give priority to quality as an evaluation of excellence (Alkhattabi et al., 2010). For example, in TVE developmental projects in Bahrain, top priority was given to restructuring the learning content, adopting new teaching and learning methods, and integrating technology in the learning environment. On the other hand, less attention was given to evaluating the effectiveness of the newly developed projects and their characteristics. It was also indicated that a specific framework for evaluating e-learning systems in TVE was essential in evaluating their effectiveness.

It was obvious that pedagogical and technological aspects could not continually improve without a quality evaluation process. Educators believed that using an information quality framework would assist TVE people to measure e-learning content effectiveness and motivate them to create innovative content that meets modern and local industrial needs.

Table 1 presents various information quality frameworks which grew from the original work of Wang and Strong (1996). It is apparent that the frameworks have the same four quality factors as presented by Wang and Strong; however, differences appear in the quality dimensions. The justification was that each framework was formulated as per specific requirements.

In total, 19 quality dimensions were found in the literature. The authors believe that these frameworks are generic and could be used for any e-learning systems content. For the purpose of this paper, some specific elements have been added to measure pedagogical issues that are related to specific industrial needs. The next section presents the extended information quality framework. A closer scrutiny of this model suggests that it does not include quality of the e-learning content corresponding pedagogical and industrial work place requirements. At best the model is generic and cannot be used to specific engineering application based courses.

Table 1: Comparison of Data/Information Quality Frameworks



5- The extended information quality framework

The model is to evaluate the content of e-learning packages in EECs with respect to two aspects, pedagogical and technological.

Figure 3 presents the extended information quality framework. It incorporates specific pedagogical and technological aspects as per modern industrial requirements. The e-learning system content from the technological aspect considers the following quality factors: intrinsic information quality, contextual information quality, and accessibility information quality. These factors are combined from existing information quality frameworks. The pedagogical aspects in the e-learning system content are represented as information quality factors, incorporated from the literature (interpretability, ease of understanding, representational consistency, and concise representation) as well as modern industrial needs (depth of knowledge, personal attributes, motivation, and integration of skills). In addition, one pedagogical quality element (interactivity) was added to accessibility information quality.

The quality dimensions of the framework should be critically integrated and considered while developing the content of EECs in a TVE system. The framework should be used as guidelines to evaluate the effectiveness of the content of the e-learning system. In addition, some quality dimensions which are related to pedagogical aspects were added to extend the existing quality information framework. The purpose was to meet the identified specific industrial needs. Also, the extended model should assess the integration of pedagogical and technological aspects of EECs.

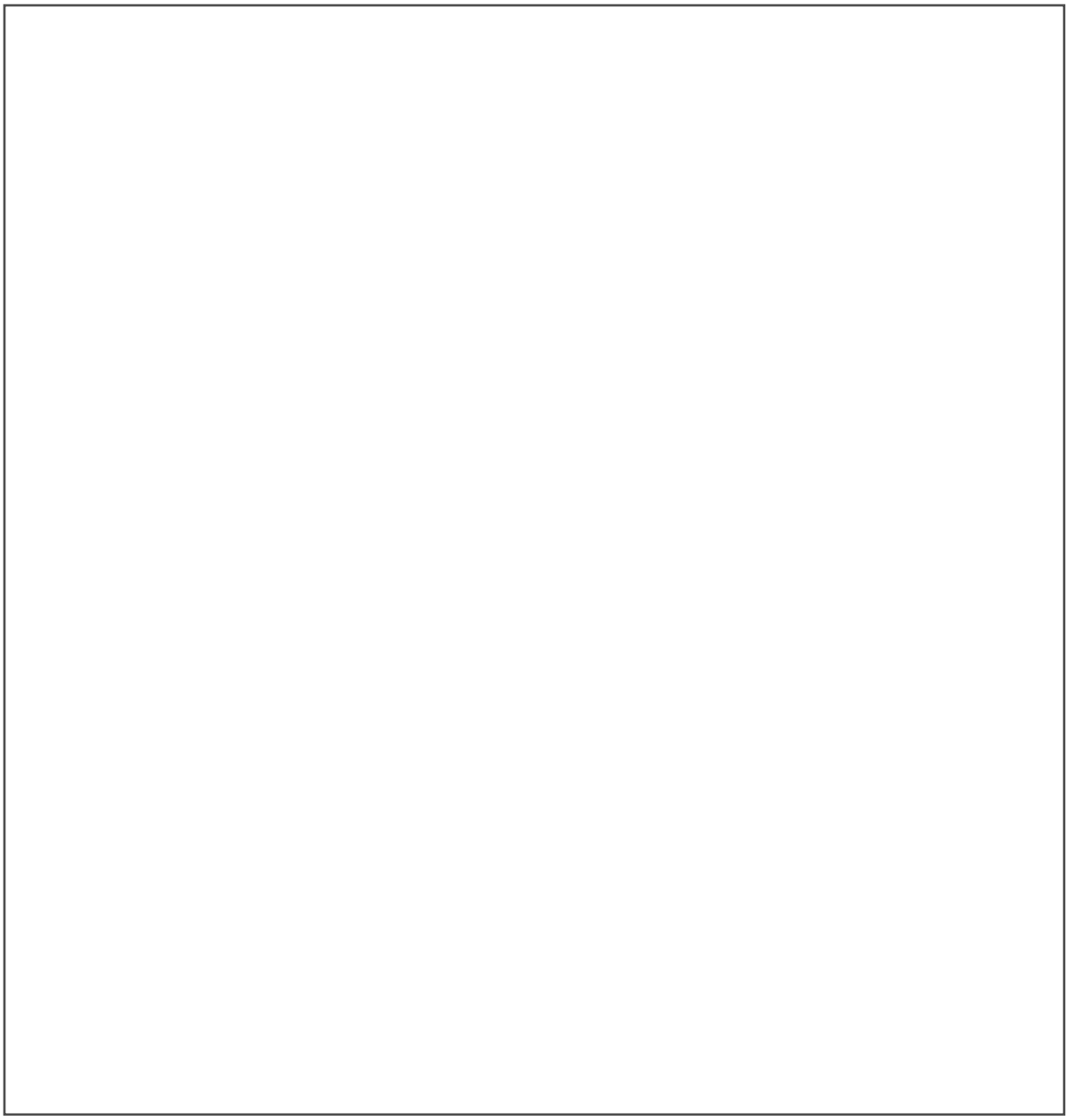


Figure 3: The Extended Information Quality Framework

6- Conclusion

An extended information quality framework has been developed. The developed framework could be used to measure the effectiveness of e-learning content for EECs in TVE systems. The model has been developed on the basis of educational goals (TVE goals), modern industrial requirements, and existing information quality frameworks. The extended model incorporates

pedagogical and technological aspects. The model is consistent with both educational objectives and industrial requirements. The extended information quality framework will be used to evaluate the effectiveness of EECs in TVE system. The framework will be used as a diagnostic quality tool to benchmark the EECs for future improvement.

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