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Towards Identifying Quality Assurance Standards in Virtual Learning Environments for Science Education

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ABSTRACT

Many studies indicated the beneficial impacts of Virtual Learning Environments (VLE) on teaching and learning experience (Barbour & Reeves, 2009). Therefore, quality and standardisation of e-learning have become a crucial success factor to ensure the quality of learning and to maximize benefits gained from such learning experience. This research sought to identify and propose a set of standards for VLEs in science education so as to ensure the quality of these environments and maximize the learning benefits for students. A wide range of studies have been analyzed in order to identify the main dimensions of VLE from which quality standards should be derived. Hence, an evaluation form with six main standards was developed based on previous studies. It was then distributed to purposively selected panel of experts who ranked on a 3-point scale and determined the importance of each standard. The ranking of these standards was done by the panel of experts from Saudi, European, and Malaysian universities with different backgrounds. These standards, arranged in their order of importance, are: design, support, authority and safety, improvement and review, VLE cost effectiveness, and quality VLE software. Moreover, the findings indicated that the devised form is suitable to be used as an evaluation tool to assess the quality of VLE for science education.

Keywords: Virtual learning environments, VLE, total quality, standards, science education, virtual environments

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INTRODUCTION

A learning environment is defined as a group of circumstances and factors that learners interact with and are influenced by them. They characterize the educational situation and give it its uniqueness. Research has shown that the learning environment affects the learner according to the degree of its

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authenticity (Khamees, 2003). However, when it is difficult to provide this kind of environment, simulated environments are the most suitable alternatives (Ibid).

Using simulations and virtual reality, which have become well established during the last ten years, have made it possible to design simulated learning environments using computers that may sometimes surpass the real, natural environments (Hamit, 1993; Helsel, 1992). Virtual reality is interactive as it responds to users' actions and behaviour. In fact, it provides a degree of interaction that is not possible in traditional multimedia since it allows users to go anywhere and discover any place in the virtual reality environment (Berge & Clark, 2005). Virtual reality has become a new method of learning using computers that adds a wide range of scientific imagination and learning possibilities to individuals (Chow, Andrews, & Trueman, 2007). It also offers an individualized learning experience that fulfills the educational needs of students with different learning styles, in addition to VLE's flexibility in terms of time and place (Barbour & Reeves, 2009). Moreover, one of its most important advantages is the ease of continuous renewal of the information provided, which helps make learning more enjoyable and individualised (Al-Shanak & Doumi, 2009).

Although virtual reality emerged as an area of distinction for computer applications during the eighties, this technology is still considered in its early stages of development. So far, there has been little research on this technology, particularly with regard to its educational applications. Its novelty has led researchers and educators to exert huge efforts to build a theoretical and conceptual basis for this emerging technology and its potential (Clark & Berge, 2005; Mclellan, 1996).

With the increasing need for virtual learning technology, both locally and internationally, the development of virtual learning environments has become a science with its own foundations and origin. The development of educational materials and learning environments is no longer left to personal efforts. In fact, it now has its internationally known principles and standards, especially after the development of quality concepts. Thus, quality assurance has become a very important issue because virtual learning universities and institutions cannot be accredited without subjecting them to quality standards. If we look at the reality of science education today, especially in the Arab region, we find that the learner's knowledge acquisition depends mainly on theory rather than practice and experimentation of newly acquired knowledge in real life. This is due to many reasons, which include the lack of suitable equipment and lab instruments, the risks and dangers of some laboratory experiments, and the high cost of materials and shortage of time (Al-Radi, 2008).

A virtual environment that is well-designed provides learners with authentic learning experiences that enable them to transfer what is happening within the virtual learning environment, in terms of skills, experiences and experiential learning acquired to real life situations.

SIGNIFICANCE OF THE STUDY

The First and Second International Conferences of e-Learning and Distance Learning, which were held in Riyadh in March 2009 and February 2011 subsequently, recommended activating the roles of professional institutions and specialized groups in emphasizing quality control procedures in e-learning and distance learning contexts. They also suggested establishing a clear policy for encouraging and supporting interested staff and students. Furthermore, standard tools should also be developed and adopted to determine the extent of readiness to plan and apply e-learning at universities and other academic institutions (First International Conference of e-Learning and Distance Learning, 2009; Second International Conference of E-Learning and Distance Learning, 2011).

The benefits or the advantages of virtual learning in general and in science education in particular, and the widespread nature of its applications around the world, have led to increasing attention to improvement of its quality. The issue of quality assurance in virtual learning has become a new challenge to e-learning in higher education. Ignoring this challenge means that e-courses and programmes created will neither be recognized nor certified and lacking in quality. This challenge is faced by most traditional universities, and all virtual universities based on e-learning (Al-Mulla, 2008).

It is well known that even the world's leading universities have started to provide virtual academic programmes. These include Harvard University, Berkeley University, University of Massachusetts, Stanford University, The British Open University, University of London, and University of Oxford. The Quality Assurance Agency (QAA) for Higher Education in Britain pays a special attention to assuring the quality of electronic and virtual learning programmes (QAA, 2010). Indeed, there are some virtual universities that offer their educational services using purely virtual methods, including admission and registration, evaluation and granting of degrees. Among these universities are Jones International University in the United States of America and the International Management Centre's Association in Britain (Middlehurst, 2002).

Therefore, the assurance of quality in virtual and e-learning is a very important issue for any academic courses, programmes, and educational environment. If quality is a prerequisite for the success of the educational process in general, it is essential for virtual and e-learning in particular. Since the concept of quality in virtual and e-learning is associated in the literature and recent studies with the outcome of the educational process, most definitions of quality in e-learning have described it in terms of measuring or testing the effectiveness and quality of e-learning programs in accordance with standards and benchmarks (Barker, 2007).

Based on the foregoing, the issue of ensuring the quality of virtual and e-learning programmes is subject to the adherence and conformity of these programmes to the quality standards issued by professional non-profit organizations. Therefore, it is

crucial to develop appropriate criteria and measures to insure the quality of these programmes (Al-Mulla, 2008).

In light of these issues, the aim of this study was to set mechanisms and standards so as to ensure quality and validity of virtual science learning environment. Therefore, this study sought to construct a concept proposal and frame of reference for the future to ensure the quality of virtual learning environments, especially in view of the lack of such studies in the Arab World in general and in the Kingdom of Saudi Arabia in particular.

RESEARCH QUESTIONS

The objective of this study was to identify standards for the quality assurance model of the science virtual learning environments, and rank the standards in their order of importance.

The study aimed to answer the following key questions:

1. What is the proposed view of virtual environments of science education in the light of total quality standards?
    - 1.1 What are the important standards that can be included in the quality assurance model of VLE for science education and virtual laboratories?
    - 1.2 To what extent are these standards important in order of ranking to ensure the quality in VLE of science education?

RESEARCH HYPOTHESIS

Recent research has proven the importance of quality assurance in VLEs (Al-Shanak & Doumi, 2009). In this paper, we sought to identify these standards based on research in the area of quality assurance in VLE for science education. However, we believe that these standards vary in importance, and that prioritizing them will better ensure the quality of VLE. Hence, the aim of this paper was to identify and prioritize these standards based on previous research in the field, as well as input from experts in the field of VLE and E-learning.

LITERATURE REVIEW

The Importance of VLE in Education

In order to define and develop quality standards for VLEs, it is important to review and point out the factors that facilitate its effectiveness and usefulness. For this purpose, the researchers set the study of Barbour and Reeves (2009) as the starting point. This study focused on revising previous research, which dealt with the current status of virtual schools between 2004 and 2008. This study also differentiated between the various types of virtual schools on the basis of learning type, namely, synchronized, asynchronized or an independent virtual school. The researchers in this study have pointed out some of the educational benefits of virtual learning. The most significant ones can be summed up as follows:

- The ability to offer an individual sophisticated learning programme that is customized to meet the particular requirements of a certain student to fit his or her own learning style,
- The flexibility in terms of time and place,
- The enhanced opportunities for disabled students whose disability otherwise prevented them from pursuing a conventional education,
- Providing higher levels of motivation,
- Widening the coverage of educational services,
- Offering high-quality educational opportunities,
- Improving the skills and results of students, and
- Offering the opportunity for multiple educational options (Ibid).

Barbour and Reeves (2009) also pointed out the challenges that virtual education faces, such as the nature of the students and the need for them to have positive attitudes towards self-study, the technical skills needed, enthusiasm for the educational method in use and time management skills. The study concludes by emphasizing the importance of assessing the functionality of the virtual science learning environments, in addition to assessing the extent to which these environments provide the expected benefits both for the teacher and the students.

The integration of VLEs in education has been proven as useful and beneficial for students' attainment in many studies. The study of Abofakhr (2008) used the pre- and post-test method to measure students' attainment as a result of using VLEs in a sociology course at the Syrian virtual university. Among the most important conclusions of the study is that the attainment level of the experimental group students, who were taught via the virtual university, increased as compared to their counterparts who had studied the same module within the framework of conventional education at the University of Damascus. In addition, there were differences in the results of the pre-test and post-test to which the students of the experimental group were subjected. The results are in favour for the post-test which provides strong support for the effectiveness of learning via a virtual university.

The study of Meisner, Hoffman and Turner (2008) used pre- and post-test in a science course. The researchers conducted a pre-test on the students who were to be involved in the experimental sample before allowing them to use a high-quality VLE, which consisted of a virtual physics lab. Then, after one semester, the researchers conducted a post-test which further demonstrated the effectiveness of VLE, as students' attainment improved. In addition, the test revealed their perceptions and positive attitudes towards this type of learning. According to the researchers, the study lends strong support to the view that the attainment level of students being taught via VLE is far better than those taught in a conventional learning environment.

Finally, the study of Al-Husari (2002) sought to identify the perceived benefits of

using VLEs from the students' viewpoint. Students pointed out that the programme helped them to understand scientific processes and the concepts that they usually found difficult to grasp through conventional methods. In addition, these programs also gave them the chance to understand the changes that occur as a result of conducting a physical or chemical experiment. Moreover, the VLE helped to increase students' concentration and attention, as well as increasing the students' contribution and interaction. It also developed the students' sense of responsibility for their own learning.

Quality Assurance in VLE

Ensuring the quality of VLE becomes essential in order to achieve the educational benefits presented above. In this regard, it is useful to point out that quality assurance in virtual learning is a concept that is in the interests of all stakeholders, as academic accreditation agencies call for this quality, and users of these environments expect it. Moreover, teaching staff need it in order to support their educational role (McLoughlin & Visser, 2003;Wang, 2006). Therefore, governmental quality agencies and educational institutions throughout the world exert their best efforts to address the challenges which arise from the use of VLEs around the world. One particular example of this interest in quality assurance is the survey carried out by the UK's OFSTED (Office for Standards in Education, Children's Services and Skills) (Ofsted, 2009) which reported that a lot of participants expressed their concern about quality assurance of VLEs being used in British schools. They have also emphasized the importance of having official procedures to assure the quality of VLEs in education in general as well as in specific content areas.

In general, the quality standards for VLEs should take the needs of all the stakeholders and beneficiaries into consideration, namely, the students, the teacher and the educational institution (Middlehurst, 2003). In this regard, the British agency for the quality of higher education (the QAA) is concerned with setting uniformed standards to assure their application within the framework of higher education in general and all forms of electronic education in particular. The main point on which the concept of quality of electronic education is established and of which virtual learning falls under can be summed up under the following headings: ease of access, arrangement of educational content, delivery system, student support, communication and interaction, and evaluation (QAA, 2010). Frydenberg (2002) proposed and discussed a set of general standards to be used to assess the quality of electronic education, and also defined the criteria that should be covered by each standard. These standards are as follows: institutional commitment, technology, students services, curriculum design and development, education and teacher, delivery system, financing, legal issues, and evaluation. The study of Chibueze (2008) agrees with the former studies in terms of general quality standards which include institutional support, curriculum development, the process of teaching and

learning, structure of educational content, students' support, teaching staff's support, examining and evaluation, and ease of access.

In this regard, Fyodorova (2005) studied the implications of the theory of multiple intelligences on the quality of virtual education. This study is very useful for the present study because of its comprehensiveness and specificity concerning all of the components of VLE and because of the framework proposed by the author for assessing and designing VLE. The evaluation standards include gaining students' attention, identifying the learning objectives, stimulating recall of prior knowledge, presenting the content, extracting and providing feedback, estimation, improving retention and transfer, assessment, improving the process of saving and transferring information, providing a variety of educational content, creating interaction that attracts attention, providing instant feedback, encouraging interaction with other students and teachers. This framework distinguishes between educational standards and technical standards, which include interface, navigation, supervision, learners' interaction, efficiency, presentation, practice activities, feedback, and course introduction.

On the regional level, Al-Mulla (2008) designed a proposed tool for quality assurance of academic programmes delivered electronically. The tool consists of 65 indicators which are divided into 9 main standards, namely, administrative, program design, curriculum design, content display, curriculum evaluation, student support, teaching staff support, other resources, and revision. Al-Mulla proposes using his tool as an indicator to evaluate the quality of e-learning programs; however, the tool does not lend itself to be used in evaluating VLE, especially ones that were designed for science education.

The study of Al-Saleh (2005) concerned with measuring the quality of e-learning by setting basic standards in order to evaluate the quality of education delivered. These standards were then categorized; each standard contains indicators that indicate the quality of the e-curriculum being evaluated. In addition, the researcher suggested a method to evaluate and measure how much a given e-curriculum meets the standards of educational design quality. These standards include institutional support, technical support, student support, teaching staff support, technology, design and development of the curriculum, visual design, the economics of e-learning system, and evaluation. As for the standard of educational design quality, the researcher allocated specific main and subsidiary standards that tackle and discuss the details of the e-learning experience. These standards include the quality of the design process, the objectives and requirements of the curriculum, the electronic content, motivation, educational strategies and learning activities, interaction and feedback, interface design, e-learning technology, evaluation of learner's performance, and evaluation of curriculum effectiveness.

The authors feel that it necessary to point out that the aforementioned quality standards lack the legally binding nature that obliges educational institutions to apply them, although these quality standards are issued by official governmental bodies and research institutions, and in some countries, these standards come from educational institutions. The standards serve as indicators and applications that can be described as complying with quality, yet these standards are not obligatory.

From the studies presented above, it is evident that there are common quality standards shared among these studies despite the different terms used to identify them. Therefore, the researchers attempted to point out and categorize these standards in order to understand the multiple dimensions of quality in VLE. It can be concluded that these standards fall mainly under three headings institutional, educational, and technical standards. These standards were further examined in more detail to improve their accuracy and representativeness, and this resulted in other standards such as the evaluation of the learning experience, which was labelled in Chibueze (2008) as the standard of "examining and evaluation", and in QAA (2010) as "evaluation". Moreover, different studies discussed standards related to support, whether it was "students services" (Frydenberg, 2002) or "staff support" (Al-Mulla, 2008) or even "technical support" (Al-Saleh, 2005), in which they were all grouped in this current study under management and support standards.

Dimensions of Quality

In this paper, a wide range of studies were analyzed to identify the main dimensions of VLE quality standards. This was achieved through reviewing the studies which are related to total quality standards within programmes and educational institutions that apply virtual and e-learning. The most important dimensions were identified, and these should serve as the basis for the quality standard within the virtual environment. The dimensions are as follows:

1. The institutional dimension: This concerns with the administrative and management issues such as organization, certification, finance, investment returns, information technology services, educational development, marketing services and academic affairs such as teaching staff support, educational affairs, work load, class size, salaries, and intellectual property rights. Finally, student services include pre-registration services, programme information, counselling and guidance, financial support, registration, fees, library support, and social support networks.
2. The educational or pedagogical dimension: This refers to teaching and learning. This dimension is concerned with issues related to objectives, content, design and presentation methods, and teaching strategies. There are varied educational methods used in the science education VLE for instance: physical simulation, procedural simulation,

situation simulation, and process simulation.

3. The technological dimension: This examines the issues regarding technological infrastructure of the learning environment. This dimension includes the design and planning of the infrastructure, hardware, and software.
4. Interface design dimension: This refers to the overall appearance of VLE programmes including the design of the website, content design, browsing, and user-friendliness.
5. Evaluation dimension: This includes evaluating students learning and the learning environment.
6. Virtual learning management dimension: This refers to the maintenance of the VLE as well as information distribution.
7. Resource support dimension: This examines the guidance support, technical support, vocational guidance support, and the resources required to support the VLE.
8. Ethical dimension: This refers to the social cultural and geographical variation, as well as variation among students, courses of action and legal actions such as: regulatory policy, copyright and plagiarism.

METHODS AND ANALYSIS

This study followed the descriptive analytical method as it is the most suitable method for this type of research because it operates on the basis of hypothesis and it involves the collection of data in order to test the hypothesis and to answer questions concerning the research subject and explain these answers qualitatively and quantitatively (Cohen, Manion, & Manion, 2000). Knowing that there is a limited number of experts in the area of VLE for science education, the study used purposive sampling technique and the participants were chosen based on who was thought to be appropriate for the study. The sample consisted of 30 educational experts from Saudi Arabian, European, and Malaysian universities, specialized in science education, pedagogy, psychology, educational technology, e-learning, virtual learning, information systems, and computer programming, in addition to specialists at National and International Academic Standardization Organizations.

In order to answer the first research question, a large number of studies that tackled the quality of virtual environments and e-learning have been analysed. One area of difficulty was that of defining distinctive standards for VLE in particular since most of the work concerned with quality was designed for e-learning and there is a lack of research in the field of VLE quality standards. To remedy this lack, an evaluation form containing six main standards of quality in VLE on a 3 point scale was designed to identify the importance of each standard making (3) the most important.

Based on the research discussed above, the six main standards that have been identified are as follows:

1. The design standard. This was divided into three subsidiary standards: (i) standards for quality design of virtual science education environment dimensions and components, (ii) standards for quality instructional design, and (iii) standards for quality technical design.
2. Standards for quality VLE software.
3. Support standards. It was divided into four subsidiary standards, namely, institutional support, student support, faculty support, and technical support.
4. Authority and safety standards.
5. Improvement and review standards.
6. VLE cost effectiveness standard.

As previously mentioned, the form contained the six main standards as main headings. Under each standard, there are sub-standards and statements that describe the highest level of standard performance of VLE. To answer the second research question, the participants were asked to specify the importance of each standard and its indicators.

The processes of designing, building and applying the proposed evaluation form for the standards of VLE of science education passed through many phases, as summarized in the following:

The first phase: Identifying VLE for science education quality standards. This was achieved by viewing earlier studies which are related to total quality standards of educational programmes and institutions which apply e-learning and virtual education. We also researched the foundations of virtual and e-learning within the field of science education. Then, Fig.1 was devised to indicate the dimension of the science virtual learning environment.

The second phase: After designing the visual representation of VLE dimensions, the six main standards and their indicators

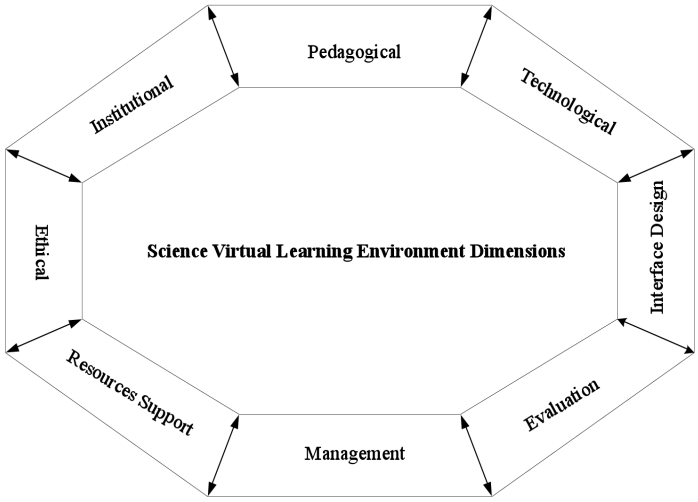

Fig.1: Science virtual learning environment dimensions.

were derived from the VLE dimensions. Since these dimensions cover a wide range of topics, some of the derived standards overlapped; therefore, we took the decision to avoid overlapping and create the six standards which in some cases combine two dimensions together. For example, the "design" standard was derived from the "pedagogical", "technological", and "interface design" dimensions.

The third phase: This phase was concerned with ensuring the validity and usability of the evaluation form. A face validity check was applied as the form was presented to 15 experts who specialize in science education, educational technology, psychology, and educational design to verify that the indicators of the form serve their objective. After making some amendments and changes to the vocabulary of the form suggested by the experts, they agreed that the form is valid for application.

The fourth phase: The phase aimed to measure the internal consistency of the evaluation form using Cronbach's Alpha coefficient, which indicates the average correlation of all the items in any scale (Pallant, 2001). In the pilot study, when the Cronbach Alpha coefficient was calculated, an overall coefficient of (0.90) was obtained. Given the nature of the form, the Alpha value was considered to signify adequate reliability.

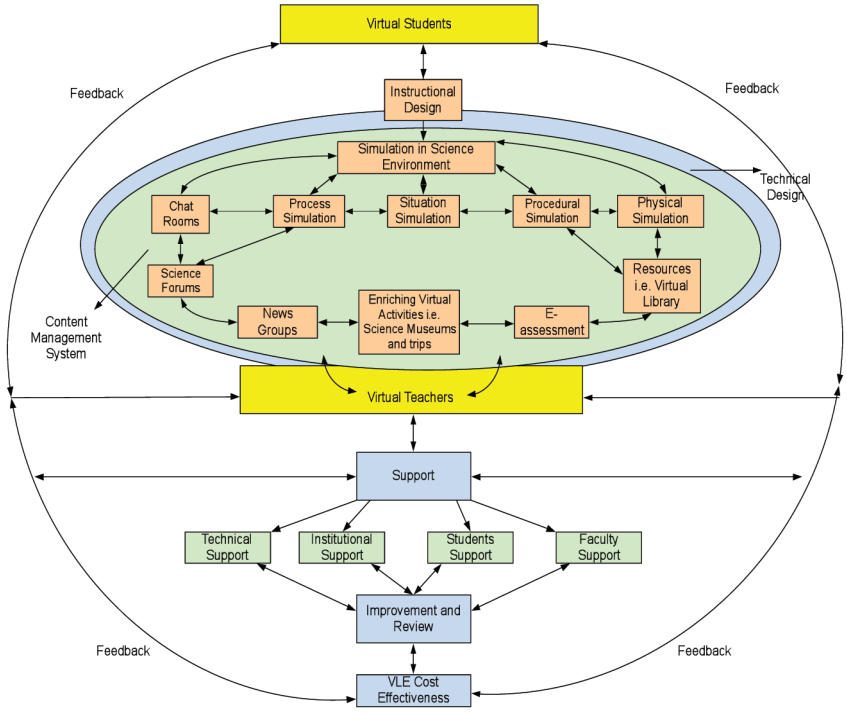

Fig.2: Proposed visual model for the virtual science learning environment in relation to total quality standards.

The fifth phase: In this phase, the evaluation form was distributed to 30 experts who specialized in science education, educational technology, computer teaching methods, and e-learning in Saudi, European, and Malaysian universities.

Having satisfactorily addressed the two subsidiary questions, the researchers turned their attention to the main question: What is the proposed view of virtual environments of science education in relation to total quality assurance standards? A wide range of studies and websites which tackled issues related to virtual and e-learning quality design were consulted. In the end, the researchers came out with a proposed model, as shown in Fig.2.

Fig.2 demonstrates how the proposed virtual science learning environment model was designed in relation to total quality standards proposed above. The model was designed to serve the needs of both the virtual teacher and virtual students to provide and ensure a quality learning experience. The function of the components of the VLE aligns with the standards presented above. As shown, the support standard is represented in this model in terms of technical support, institutional support, student support, and faculty support. The improvement and review standards as well as the VLE cost effectiveness standard are also clearly presented. The arrows represent the interaction and feedback between all the VLE components, including the inputs and outputs. These connections create a comprehensive system that is bounded to its component through continuous cause-and-effect relations.

The VLE is situated within the content management system that applies all technical design standards. The VLE contains virtual classes which are distributed in the virtual environment, providing various access points for national and international networks, e-mail, mail groups, telnet, video on demand (VOD), interactive televisions, instant and international educational materials (Al-Mubarak, 2004). In these classes, students learn through simulations which were designed according to instructional design standards, quality design standards of VLEs, and standards for quality VLE software. Students can conduct scientific experiments within virtual laboratories by dealing with the variables which they cannot deal with in real life. Within the frame of VLEs, students are left on their own to try, explore, inquire, analyze and build their own knowledge all by themselves (Gerval & Le Ru, 2008). In any learning experience, moreover, students are assessed to evaluate their progress and to identify the weaknesses and strengths; it is important to note that the VLE e-assessment is also subjected to quality technical design standards.

In this VLE model, students can visit scientific clubs, science museum, virtual libraries, and practice a wide variety of enriching activities which enable them to gain authentic experience; all of which were designed according to quality VLE design standards (Hin & Subramaniam, 2005). The continuous communication between teachers, students, and administration plays an important role in this model. The VLE communication tools were designed in accordance with technical design standards.

They enable synchronous and asynchronous online communication via email, chat rooms, science forums, news groups, and video conferencing so as to allow interaction with others who are parts of their educational experience (Ellis & Calvo, 2007).

FINDINGS: SEMANTIC ANALYSIS AND INTERPRETATION OF THE RESULTS

Data acquired from the experts were processed and analyzed. The analysis included frequencies and percentages, in addition to Chi-square test. The appendix shows the form in full length and the percentages for each indicator. The form in the appendix shows that there are statistical differences in arranging the degree of importance of the main and subsidiary standards of virtual sciences learning environment, which reflect its importance from the participants' point of view. This is applicable at levels 0.05 and 0.01 in all of the main and subsidiary standards, which means that the hypothesis is acceptable on the basis of these indicators. The Chi-square test was used to identify the extent of the significance of differences in arranging the degree of importance of each standard. The values of $\chi 2$ were proven to be significant at all of the indicators, except for 10 indicators; namely, 27-28-29-31-45-67-68-105-164-165. This means that no differences were detected in the experts' opinions about these ten indicators. Significant value of $\chi 2$ means that there is a variance in the respondents' opinions, which is a result of the unequal frequencies in any indicator.

Through the study and the analysis of the form, we may infer that there is a meaningful statistical difference in arranging the degree of importance of VLE design standards in light of total quality standards which reflects the variance of their importance in the experts' point of view, and this offers strong support to the study's hypothesis.

The Relative Importance of the VLE Main Standards Indicated By the Experts

Table 1 and Fig.3 show that the percentage of the arithmetic average of the VLE standards exceeding 90%. This means that these standards are perceived as highly important, and this places heavy emphasis on using these standards as a tool for the purpose of

TABLE 1
The frequencies and percentages of the relative importance of VLE main standards arranged according to the order of importance

Rank	Main Standard	Frequencies	Mean Value	The mean average percentage
1	Design	345	316.3667	91.70
2	Support	177	162.0000	91.53
3	Authority and Safety	48	43.7000	91.04
4	Improvement and Review	42	38.1667	90.87
5	VLE Cost Effectiveness	33	29.9000	90.61
6	Quality VLE Software	60	54.3000	90.50

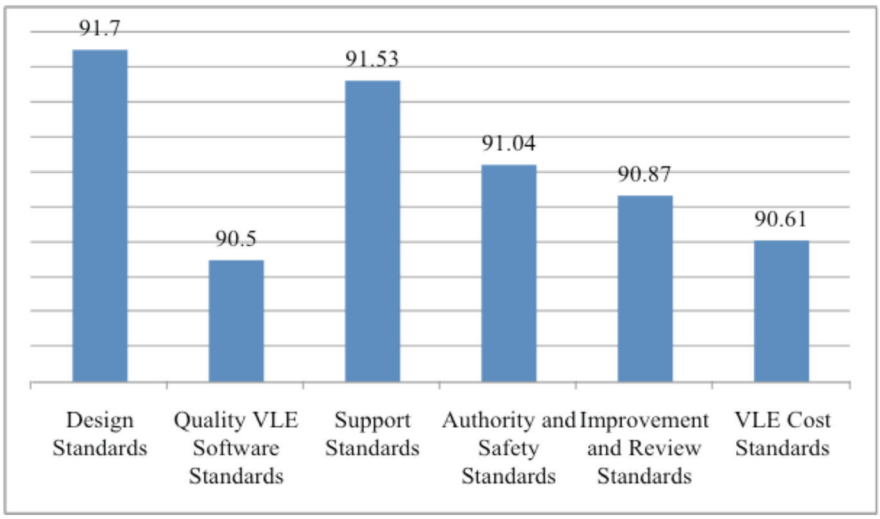

Fig.3: The percentage of the relative importance of VLE main standards

evaluating virtual learning environments in general, and science education learning environments in particular. We may also notice that the "design standard" has been ranked as the standard with the highest percentage of 91.7%.

We think that the reason behind this high percentage is that the virtual science learning environment, including its components of hardware and software's ultimate accuracy, is in its design and development, as design is the basic pillar on which the virtual environment is based, and the foundation which supports all of the other standards. The "support standard" came next in importance according to the experts' view, with an average that reached 91.53%. We regard this standard as an important one and it is deservedly ahead of the other standards since earlier studies ascertained that the quality of VLEs cannot be guaranteed without supporting systems. This goes along with the study of Moore (2002), which focused on the importance of support standard, and the satisfaction of teaching staff, as well as students who use the VLE. In the third place, the "authority and safety standard" came third, and the "improvement and review standard" came fourth. The "VLE cost effectiveness" was ranked fifth, and finally, the "quality VLE software" came in last. We consider the fact that the quality VLE software standard came in the last position as not indicating insignificance of the standard. On the contrary, its arithmetic average was 90.5%. This reflects the close similarity of the respondents' views regarding the importance of the main standards of VLEs. Among the studies which emphasized on the quality of VLE and discussed similar standards are the studies of Al-Husari (2002), Al-Mulla (2008), and Al-Shanak and Doumi (2009).

The Relative Importance of the VLE Subsidiary Standards Indicated by the Experts

Table 2 and Fig.4 show that the subsidiary standard of "quality design dimensions and components" was ranked as first as its arithmetic average reached 97.42%. The reason for its high ranking was the main standard that it is related to was also ranked as first. Moreover, many studies have asserted the importance of setting accurate and clear indicators of the quality design of VLE dimensions and components, and the experts who participated in this study seem

TABLE 1
The frequencies and percentages of the relative importance of VLE subsidiary standards arranged according to the order of importance.

Rank	Subsidiary standard	Frequencies	Mean value	The mean average percentage
1	Quality design dimensions and components	66	64 .3000	97.42
2	Institutional support	42	39.1000	93.1
3	Technical support	24	22.2333	92.64
4	Quality instructional design	129	117.6667	91.21
5	Authority and safety	48	43.7000	91.04
6	Faculty support	45	40.9000	90.89
7	Improvement and review	42	38.1667	90.87
8	VLE cost effectiveness	33	29.9000	90.61
9	Student support	66	59.7667	90.56
10	Quality VLE software	60	54.3000	90.5
11	Quality technical design	150	134.4000	89.6

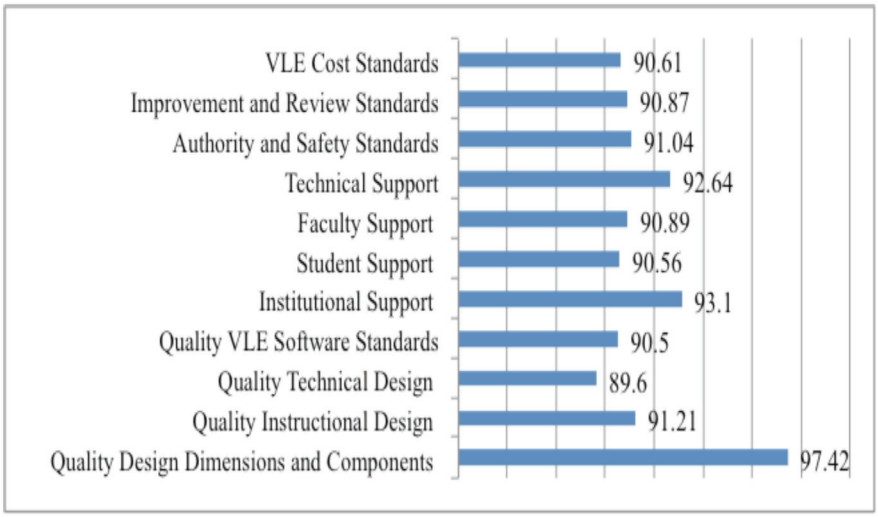

Fig.4: The percentages of the relative importance of the VLE subsidiary standards

to agree with these studies (e.g., Abofakhr, 2008; Al-Mulla, 2008; Al-Shaer, 2008). The "Institutional support" came second with 93.01%, followed by the "Technical support" that came third with 92.64%. The fourth was "Quality instructional design" with 91.21%, while "Authority and Safety" was fifth with 91.04%. The sixth was "Faculty support" with 90.89%, followed by "Improvement and review" with 90.87%. The eighth was "VLE cost effectiveness" with 90.61%. The ninth was "Quality VLE software" with 90.5%. The eleventh and last was "Quality technical design" with 89.6%. We believe that the last ranking of this particular standard does not mean that the survey participants have underestimated its importance, since it has a high percentage of 89.6%, and this value is regarded as high. The reason behind this ranking can be attributed to the fact that the technical quality design of VLEs refers to the comprehensive appearance of the environment including website design, pages design, content design, browsing, and usability. These minor details could be of little importance after fixing the cornerstone of the components and dimensions of the VLE design quality.

CONCLUSION AND IMPLICATIONS

Many studies which have been reviewed highlight the benefits of using VLE in education. However, these benefits are not possible to be achieved without ensuring the quality of VLE. Therefore, this study aimed to identify the quality standards of VLE and present them in a form that should be used to evaluate quality level in VLE for science education. In addition, it endeavoured to rank the quality standards in the order of their importance. This study is very thorough and detailed because of the importance and multi-faceted nature of the topic. It managed to identify six main standards for quality in VLE ranked in order of their importance. These standards are Design, Support, Authority and Safety, Improvement and Review, VLE Cost Effectiveness, and Quality VLE Software.

Ensuring the quality of VLEs requires a pluralistic approach that covers all details of the learning and teaching experience. Therefore, the designed form which contains six standards and eleven sub-standards covers every possible aspect of the VLE for science education and pays equal attention to all factors contributing to the beneficial use of VLE. In order to benefit from all the fruitful results promised by VLE, we therefore recommend using the proposed form as an evaluative tool to assess any current VLE or new ones to be implemented. However, given the rapid change and development in the field of VLE, it is suggested to continue researching and creating adaptable new standards as tools to measure and ensure the quality of VLEs.

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APPENDIX

The Percentages of the Main and Subsidiary Standards of the VLE Standard Form related to Total Quality Standards.

Main Standard	Indicator	Degree of Importance %		
		3	2	1
1. Design Standards	**1.1 Standards for Quality Design of Virtual Science Education Environment Dimensions and Components**	67.7	23.3	--
	1. Availability of high quality physical, social, cultural, and psychological dimensions in VLE.			
	2. Design and build VLE according to "Universal Design" protocols because it satisfies learners' needs with varied learning styles and multiple intelligence including special needs and gifted learners.	83.3	10.0	6.7
	3. VLE and laboratories for science education are designed and developed by a specialised team of programmers, engineers, instructional and curriculum design experts in science education, and psychologists.	80.0	20.0	-
	4. Availability of science education virtual tools and materials designed according to virtual reality technology.	80.0	16.7	3.3
	5. VLE design should be safe, secure, and convenient.	73.3	23.3	3.3
	6. A clear vision on the design of VLE correctly based on the standards of accredited national and international institutions.	73.3	23.3	3.3
	7. High quality specifications and standards for VLE design.	73.3	26.7	-
	8. Clear rules and regulations to be practiced in VLE.	70.0	30.0	-
	9. Clearly stated and formatted general aims of VLE.	73.3	26.7	-
	10. The general aims of VLE are based on philosophical principles of constructivism, brain-based learning, and active learning methods.	53.3	33.3	13.3
	11. Availability of high tech equipment to embody sophisticated scientific phenomena.	83.3	10.0	6.7
	12. Availability of two types of learning in VLE: synchronous virtual learning and asynchronous virtual learning via the internet such as email, chatting, e-forums, bulletin boards, video and audio conferencing, and news groups.	70.0	30.0	-
	13. Availability of virtual library that contains specialized electronic resources in natural sciences.	73.3	26.7	-
	14. The virtual library is organized in a way that assists in searching, displaying, and using of information. And allow electronic treatment of information by matching learners' needs with electronic resources memory for instructional activity.	70.0	30.3	-

1. Design Standards	15. There are clear input, process, output of VLE related to different aspects of learning i.e. cognitive, skills, and emotions.	67.7	20.0	3.3
	16. There are clear instructions of procedures to be followed in using VLE technologies.	80.0	16.7	3.3
	17. VLE supports collaborative learning through its virtual software.	60.0	26.7	13.3
	18. Availability of virtual lab software designed and programmed in cooperation with high quality academic, research, and manufacturing institutions.	73.3	20.0	6.7
	19. Availability of electronic infrastructure, networks, and physical facilities for E-Delivery system.	90.0	6.7	3.3
	20. The choice of E-Delivery system should be based on the requirements of the principles of science of instruction and learning.	76.7	20.0	3.3
	21. Availability for simulation software suitable for the field under study in VLE.	56.7	40.0	3.3
	22. Usage of delivery systems and teaching paradigms suitable for the curriculum and virtual lab.	63.3	33.3	3.3
	23. Considering of electronic waste during planning phase of VLE as well as during conclusion of contracts with companies and institutions and agree of recycling of harmful electronic waste in safe methods.	60.0	33.3	6.7
	1.2 Standards for Quality Instructional Design			
	1. There is a systematic process in designing, developing, and producing the curriculum to meet learner's cognitive, skills, and emotional needs and convert them to criteria in virtual module development.	60.0	23.3	16.7
	2. Design virtual and electronic modules to ensure cohesion and structure of content activities.	90.0	6.7	3.3
	3. Virtual module is developed on the bases of defining prerequisites and experiences in e-learning.	83.3	13.3	3.3
	4. Virtual module is developed on the bases of analysing the importance and advantages of the module from learner's prospective (Orienting Context), physical specifications of VLE (Instructional Context), and the chances for practicing newly acquired skills (Transfer Context).	60.0	40.0	-
	5. Course contains orientation activities and defined prerequisites to clarify learners' misconceptions.	66.7	33.3	-
	6. Content structure of concepts, principles, theories, and laws are defined using analysis suitable for the nature of knowledge and skills required to fulfill the module aims.	56.7	43.3	-
	7. Instructional criteria of virtual module is developed using suitable tools such as storyboarding and scenarios.	76.7	23.3	-
	8. Apply formative assessment by using Alpha and Beta testing during the production of the module to improve it according to assessment results.	66.7	33.3	-
	9. During design phase data collection procedures for module evaluation and learners' training and support are all defined.	73.3	26.7	-
	10. During design phase overall assessment procedures are defined and periodical reviews of virtual module to ensure its efficiency and competency.	70.0	26.7	3.3

1. Design Standards	11. Comprehensive syllabus of the module that clearly describe its aims and requirements on the web before commencing teaching the module in VLE.	73.3	26.7	-
	12. Virtual module syllabus describes skills and methods of performance evaluation.	83.3	13.3	3.3
	13. Module aims are formulated in procedural behavioural and measurable approach.	76.7	20.0	3.3
	14. Module aims should be achievable in light of learners' characteristics.	83.3	10.0	6.7
	15. Virtual module aims should be related to pedagogical strategies, content, learning activities and performance evaluation as an integrated system.	83.3	10.0	6.7
	16. Virtual module aims support higher order thinking skills such as critical thinking, Meta cognition, creative thinking, and decision making.	90.0	10.0	-
	17. Aims are based on life skills and continuous realistic applications in VLE.	83.3	13.3	3.3
	18. Content should be of high quality and carefully designed in terms of novelty and originality and flawless.	76.7	23.3	-
	19. Content should be flexible to cover varied VLE applications	83.3	16.7	-
	20. Content is designed and presented in purposeful organized chunks that facilitate learning.	83.3	13.3	3.3
	21. Content include trusted external links chosen of high quality and standard to benefit supporting virtual learning module activities and aims.	73.3	20.0	6.7
	22. Instructional content is logically connected and based on learner's previous experiences	66.7	33.3	-
	23. Unified user interface through out the VLE for control icons, browsing, and links.	68.7	10.0	3.3
	24. Virtual module boost learner's self esteem and capability to achieve virtual learning aims through skills and tools of self learning and evaluating included in the module.	83.3	16.7	-
	25. Course employs the use of visual thinking tools such as concept maps, logical organization of concepts, and visual maps.	70.0	26.7	3.3
	26. Course employs learning strategies suitable for its aims and requirements, and learners' characteristics and individual differences between them using synchronous and asynchronous tools.	76.7	20.0	3.3
	27. Availability of learning and teaching strategies and tools to assist learners with special needs.	83.3	16.7	-
	28. Course uses enriching and active learning activities in accordance with teaching standards.	73.3	26.7	-
	29. Learning activities offer links to enriching information suitable for learner's performance and progress.	72.3	26.7	-
	30. Instructional content in VLE is progressive in difficulty and sophistication as the learner progress in studies.	66.7	30.0	3.3
	31. Information is provided to learners on protocols of active learner-content, learner-teacher, and learner-learner interaction.	76.7	23.3	-
	32. Course utilises suitable techniques and methods to provide sufficient feedback.	70.0	30.0	-

1. Design Standards	33. Course encourages learners to provide feedback on course delivery and activities in secrecy.	76.7	20.0	3.3
	34. VLE has an electronic forum for learners in which they express their educational needs, suggestions, problems, and challenges they face.	60.0	36.7	3.3
	35. Multimedia design utilises the same basic principles of interface design (as well be noted in Technical Design Standards).	70.0	26.7	3.3
	36. Course uses authentic and real assessment methods such as e-portfolio and self assessment.	80.0	13.3	6.7
	37. Course goes through periodic review, continuous evaluation, and cost and performance measurement to ensure quality and compatibility with virtual learning programs of the institution.	80.0	20.0	-
	38. Suitable decisions are made to improve virtual course effectiveness and efficiency according to evaluation outcome.	83.3	16.7	-
	39. Availability of secure electronic system for submitting learners' tests and research papers.	73.3	26.7	-
	40. E-receipt system to inform learners and teachers of correct and approved submission of tests and research papers.	80.0	16.7	3.3
	41. Test E-Bank.	76.7	23.3	-
	42. Encourage electronic collaborative projects and virtual teams.	76.7	20.0	3.3
	43. E-publishing for learners and teachers work.	66.7	30.0	3.3
	1.3 Standards for Quality Technical Design			
	1. Put technical and presentational interface design issues into consideration such as surfing, lists, icons, font size and type, control tools, and log in –log off VLE tools.	66.7	33.3	-
	2. VLE is linked to institution's databases such as student database system and academic records database system.	66.7	33.3	-
	3. VLE is linked to central library database.	86.7	13.3	-
	4. Web technology is used to design VLE to allow access to it from any place.	70.0	26.7	3.3
	5. VLE programming is compatible with varied operating systems such as Windows and Linux.	76.7	23.3	-
	6. Server capacity is suitable with number of learners in VLE.	90.0	10.0	-
	7. Each learner is allocated a space to store personal files and documents.	76.7	20.0	3.3
	8. VLE contain repository to store instructional materials, activities, and learning resources.	73.3	23.3	3.3
	9. All file types with different extensions can be uploaded and downloaded.	76.7	23.3	-
	10. There are programs that facilitate team work such as e-calendar, bulletin boards, and forums.	80.0	16.7	3.3
	11. Instructional content can be developed easily using user friendly software without the need for prior programming skills.	76.7	20.0	3.3
	12. Availability of programs to design assessment and evaluation tools such as Visual Cert Exam.	83.3	16.7	-

1. Design Standards	13. VLE contains RSS feeds and content can be accessed offline.	83.3	16.7	-
	14. Simple user interface for VLE.	66.7	26.7	6.7
	15. Two different user interface one for learners and the other for teachers since they perform different activities in VLE.	76.7	20.0	3.3
	16. Unified interface throughout VLE.	83.3	13.3	3.3
	17. Accessible page design in terms of font size and colure, control of audio materials volume, control of picture resolution, and availability of zooming for pictures.	73.3	13.3	13.3
	18. Accessible design in terms of possibility to upload multimedia.	76.7	16.7	6.7
	19. Home page for each learner that display information such as date of last visit, number of unread replies in a thread s/he started, or number of emails inbox.	70.0	26.7	3.3
	20. Possibility to personalize pages for each learner using font size and colour and background	27.3	23.3	3.3
	21. Special needs learners are put into consideration when designing VLE learners such as dyslexic, colour blind, and short sighted.	60.0	26.7	13.3
	22. Suitable size icons with clear labels.	80.0	20.0	-
	23. Clear drop down lists with logically related items.	70.0	26.7	3.3
	24. Synchronous and asynchronous communication such as chat programs, forums, bulletin boards, email, and video and audio conferences.	80.7	16.7	3.3
	25. Availability of sensory transformers such as virtual reality glasses, helmets, and gloves	83.3	13.3	3.3
	26. Connect and use devices to interact with virtual reality in VLE such as data gloves and head mounted device and sense and motion transformers.	63.3	26.7	10.0
	27. Each learner has unique username and password for signing in VLE.	66.7	20.0	13.3
	28. Restricted learners' access to instructional content according to learner's or teaching progress (learners are only allowed access to lessons that have been taught).	80.0	16.7	3.3
	29. Possibility to track learners' activities in VLE to evaluate their interaction with instructional content.	66.7	23.3	10.0
	30. Create backup of VLE to save its content from lost in case of server failure.	73.3	26.7	-
	31. Server should be chosen according to content volume, band width, hosted files i.e. text, audio, video, and picture, and programs executed by server such as Perl Script, Java Server Pages, Active Server Program.	83.3	16.7	-
	32. Browser is used to access VLE.	70.7	26.7	3.3
	33. Availability of media player for audio, picture, and text files.	80.0	20.0	-
	34. VLE should contain a place to answer questions related to usage of VLE and virtual laboratories.	76.7	23.3	-
	35. Browsing icons support back and forward move and scrolling up and down and using help button.	76.7	23.3	-

1. Design Standards	36. Copies of some programs learners might need to brows VLE content such as Flash and Acrobat Reader.	80.0	20.0	-
	37. VLE should contain all programs learners need to operate some learning resources such as MS Word and PowerPoint.	70.0	26.7	3.3
	38. Another colour is used to distinguish electronic links in VLE.	76.7	23.3	-
	39. Concepts used in the course are defined by creating hyperlink on the word which will open a small pop on window that includes the definition.	53.3	26.7	20.0
	40. Navigation tools are designed in simple and easy to use way to move between content items.	53.3	43.3	3.3
	41. Use of simple ideational maps to present course content.	70.0	76.7	3.3
	42. All pages contain (Home) icon.	60.0	33.3	6.7
	43. Use pictorial navigation tools such as pictorial icons.	83.3	13.3	3.3
	44. Reduce text links in one paragraph to ensure non dispersion	63.3	30.0	6.7
	45. Use hyperlinks in table of contents and pick lists.	56.7	36.7	6.7
	46. Course is designed to correct all operating and use mistakes that users might fall in.	60.0	33.3	6.7
	47. Security system against electronic attacks including encryption of data exchanged between learners and educational institutions via the Internet.	73.3	23.3	3.3
	48. Availability of video and audio classes captured via webcams to activate cooperative learning environments in VLE.	66.7	26.7	6.7
	49. Maintenance and technical support are continuously available for VLE.	73.3	23.3	3.3
	50. Use wireless LAN networks for VLE.	63.3	26.7	10.0

Main Standard	Indicator	Degree of Importance %		
		3	2	1
2. Standards for Quality VLE Software	1. Programs are designed according to Internet protocols and standards.	70.0	26.7	3.3
	2. Availability of learning systems and educational content management system.	73.3	23.3	3.3
	3. Availability of automated packaging systems and standards tools.	80.0	16.7	3.3
	4. Preparation of qualified technical team to design and develop VLE with cooperation with an experienced consultant.	73.3	20.0	6.7
	5. Attention is paid to choose uncomplicated systems that do not require radical restructuring in present system and then develop system functions gradually.	73.3	23.3	3.3
	6. Establish portal systems that can provide and integrate suitable services for VLE.	76.7	20.0	3.3
	7. Availability of learning resources database programs i.e. handbook program, download programs, Microsoft Adope Reader, Acrobat, Internet Explorer and Netscape.	83.3	16.7	-
	8. Availability of Electronic portfolio program.	70.0	23.3	6.7
	9. General guidelines governing procurement and replacement of hardware and software. These guidelines always ensure development of hardware and software.	66.7	26.7	6.7
	10. Efficient infrastructure to undertake maintenance and repair operations for hardware and software.	76.7	16.7	6.7
	11. Security system to protect learners and teachers personal information, assessment and grades, and to protect VLE from viruses.	86.7	13.3	-
	12. Adapt virtual learning programs with the orientation and aims of educational institutions.	83.3	16.7	-
	13. Special programs to manage VLE and register learners in virtual learning course, and specify access rights for each user.	76.7	23.3	-
	14. Special programs that record the time a learner needed to achieve learning goals, perform activity, or conduct an experiment in virtual lab.	73.3	23.3	3.3
	15. Special programs to manage resources in VLE.	73.3	23.3	3.3
	16. Virtual lab programs contain tools that support the experiment such as graphs, animation, and statistical analysis software.	66.7	26.7	6.7
	17. Special program in VLE to develop social, behavioural, and active human communication skills to face the shortcomings of virtual learning.	63.3	33.3	3.3
	18. Special program that explain ethical, social, and cultural issues related to ICT use that is consistent with educational institution aims and orientation.	60.0	36.7	3.3
	19. Virtual laboratories software feature different environments to undertake experiments such as vacuum, water, air and dark environments.	83.3	16.7	-
	20. Virtual laboratories software features the possibility of self-assessment during solo performance of laboratory tests.	83.3	16.7	-

Main Standard	Indicator	Degree of Importance %		
		3	2	1
3. Support Standards	**3.1 Institutional Support** 1. Educational institution support for providing high quality LVE.	80.0	20.0	-
	2. Availability of strong support system for all input, process, and out put of VLE.	83.3	16.7	-
	3. Form policies and special system to support the development of virtual learning programs in VLE.	80.0	20.0	-
	4. Suitable technical criteria and financial commitment to VLE software.	86.7	13.3	-
	5. Educational institution management encourages and support virtual learning by accrediting this method of learning.	83.3	16.7	-
	6. Educational institution undertakes internal and external audits to reduce risk rate and to ensure quality control.	83.3	16.7	-
	7. Educational institution adopts system, policies, and regulations that support new VLE.	76.7	23.3	-
	8. Educational institution adopts systems, policies, and regulations that support virtual educational innovations.	76.7	20.0	3.3
	9. Provide sufficient finance to support VLE system and operation.	80.0	20.0	-
	10. Educational institution uses administrative accountability system to ensure quality control and productive usage of VLE resources.	76.7	23.3	-
	11. Encourage cooperation and partnership in resources such as e-library, distinct virtual applications, and faculty between Arab virtual universities through specific types of regulation and links to those resources (information clearing house, electronic indexes).	83.3	16.7	-
	12. Support, commitment, and continuous cooperation within educational institution to work with shared values and visions to ensure success and continuous development of quality in VLE.	83.3	13.3	3.3
	13. Extent to which salaries of supporting services workers attract job competencies to the field of virtual learning.	73.3	23.3	3.3
	14. Availability of long term plans to develop VLE's and their infrastructure.	76.7	20.0	3.3
	3.2 Student Support 1. Management system to provide registration and acceptance services in VLE.	83.3	13.3	3.3
	2. Provide learners with copies of the Student Guide to introduce them to testing system and how to answer questions besides using it as study skills guide.	83.3	16.7	-
	3. Establish a centre to assess learners' skills (proficiency assessment) to assess and develop learners' varied skills.	70.0	26.7	3.3
	4. Educational technology specialists to support students and to provide guidance and solution with regard to electronic resources technology.	73.3	23.3	3.3
	5. Availability of personalised lessons and multimedia via VLE.	60.0	33.3	6.7

3. Support Standards	6. Lay a realistic strategy to develop and support self learning and enable learners of controlling their educational progress.	76.7	61.7	6.7
	7. Availability of full and clear information for learners regarding the nature and requirements of virtual learning. Including information on the relation between achievement, attainment, assessment, academic progress, and number of hours approved.	83.3	16.7	-
	8. Provide training on VLE and how to interact with it by publishing Student Guide on VLE.	66.7	30.0	3.3
	9. Easy access to productivity tools, internet services, interactive media, and digital resources to enrich learning aims and activities.	76.7	20.0	3.3
	10. Sufficient technical support to provide maintenance, technical assistance, operation, and upgrading technical infrastructure.	70.0	23.3	6.7
	11. Start encouragement and incentives system such as giving Virtual Digital Creativity Award.	73.3	26.7	-
	12. Availability of feature that enables answering learners' questions on issues related to virtual course.	76.7	23.3	-
	13. Availability of help and guidance in all VLE pages.	66.7	33.3	-
	14. Availability of assisting tools in virtual course such as multi-language dictionary, databases, calendar, statistical software, and translator.	63.3	36.7	-
	15. Give learners a space to publish ideas and suggestions to their teachers and other learners without the use of email.	70.0	30.0	-
	16. Availability of collective communication tools among learners in VLE.	73.3	23.3	3.3
	17. Availability of contacting technical support for help when accessing the course.	73.3	23.3	3.3
	18. Direction and guidance programs for new learners to ensure full understanding of VLE.	70.0	30.0	-
	19. Continuously track services provided to learners in VLE through learners satisfaction survey.	80.0	20.0	-
	20. Security software to protect learners' files, records, and results.	80.0	16.7	3.3
	21. Receive feedback from learners on their virtual learning experience at the end of the course.	83.3	13.3	3.3
	22. Availability of educational support for learners provided by teachers in VLE.	76.7	20.0	3.3
	23. Provide training course for learners on how to use VLE and its advantages and characteristics before commencing teaching activities.	80.0	20.0	
	3.3 Faculty Support 1. Continuous professional development training courses and provides professional development resources for faculty members working with VLE. That is to ensure efficient use of VLE and virtual learning programs.	80.0	20.0	-
	2. Availability of specifications of ICT and pedagogical skills required for functioning within VLE and train faculty members on them.	76.7	23.3	-
	3. Start encouragement and incentive system to encourage faculty in contributing and participating in developing VLE.	80.0	20.0	-

3. Support Standards	4. Measure VLE performance and use benchmarking to compare it with other VLE's.	73.3	26.7	-
	5. Start a scheme that focus on improving faculty members' talents, widen their horizons, and improve their efficiency in the field of virtual learning.	73.3	26.7	-
	6. Develop training courses for faculty on using VLE materials and resources.	76.7	23.3	-
	7. Develop criteria and indicators of faculty technical performance in VLE.	73.3	26.7	-
	8. Develop professional development programs that focus on urgent problems of VLE and are directly related to faculty needs.	80.0	20.0	-
	9. Adopt effective assessing methods and provide informative feedback to improve faculty performance.	73.3	26.7	-
	10. Develop faculty performance through workshops to improve all components of VLE.	73.3	26.7	-
	11. Provide resources, references, directions and guidance on effective use of the web in teaching virtual courses.	63.3	33.3	3.3
	12. Use incentives to assist the process of increasing quality performance.	70.0	20.0	10.0
	13. Support faculty members with tutors to assist them in VLE activities.	63.3	30.0	6.7
	14. Faculty are offered a chance to express their opinions on purchasing and replacing ICT plans.	73.3	26.7	-
	15. Annual budget for training faculty and other VLE member.	80.0	20.0	-
	3.4 Technical Support 1. Provide sufficient technical and maintenance support to keep VLE in state of readiness to perform operations and achieve aims.		16.7	-
	2. Availability of special security measures i.e. learner PIN number and backup in case of system failure.	76.7	23.3	-
	3. Provision of human, administrative, and technical resources to provide supporting services. Acceptable ratio is one faculty to 25 learners.	76.7	23.3	-
	4. Train and develop administrative and technical human resources to ensure and improve quality of performance in VLE.	76.7	20.0	3.3
	5. Provisions of virtual libraries equipped according to quality in virtual learning standards.	76.7	23.3	-
	6. Provision of virtual labs and software according to quality in virtual learning standards.	80.0	20.0	-
	7. Provision of suitable financial support to operate VLE and maintain quality.	76.7	23.3	-
	8. Availability of administrative and technical team responsible for maintenance and technical support of hardware and networks in VLE.	76.7	23.3	-

Main Standard	Indicator	Degree of Importance %		
		3	2	1
4. Authority and Safety Standards	1. Create security system that protects secrecy of information.	80.0	20.0	-
	2. Hyperlinks link to safe sites that do not create problems for operating system and browser.	83.3	16.7	-
	3. Secure system that identifies each user to protect confidential information from manipulation and electronic espionage.	80.0	20.0	-
	4. Ask for information that distinguishes each learner from the other.	83.3	16.7	-
	5. Modifying information in virtual courses is not permitted without entering learner's unique PIN number.	83.3	16.7	-
	6. Virtual course is free of viruses and spyware.	83.3	16.7	-
	7. Provision of regulations and security protection for materials on synchronous networks.	73.3	23.3	3.3
	8. Availability of information of senior management with job title for academics.	66.7	26.7	6.7
	9. Provision of information on copyrighted materials in VLE.	73.3	26.7	-
	10. Provision of instructional content designers' emails to facilitate interaction with them.	73.3	23.3	3.3
	11. Identify the name of the body or educational institution that provides VLE.	63.3	30.0	6.7
	12. List the names of action team including programmers, technicians, engineers, and experts and state their qualifications and previous experiences.	66.7	23.3	10.0
	13. Preference resources, references, models, and designs that have been used in designing VLE.	70.0	26.7	3.3
	14. Assess and accredit VLE by other agencies responsible for quality and educational accreditation.	73.3	26.7	-
	15. Consider copyright, design, and intellectual property laws.	76.7	20.0	3.3
	16. Form suitable laws and policies to protect copyrights and intellectual property of instructional content produced by faculty.	80.0	20.0	-

Main Standard	Indicator	Degree of Importance %		
		3	2	1
5. Improvement and Review Standards	1. There are regulations and suitable activities to assess and review VLE design.	83.3	13.3	3.3
	2. There is assessment process and internal audit for VLE.	80.0	20.0	-
	3. There is external audit for e-learning programs.	70.0	30.0	-
	4. Learners are asked for their opinions during VLE review process.	66.7	30.0	3.3
	5. There are indicators of development and improvement in VLE in light of assessment and review results.	66.7	30.0	3.3
	6. There are indicators of periodical assessment and review for VLE programs, the results are used for improving VLE.	73.3	20.0	6.7
	7. Academic and administrative department in the educational institution (including senior management) participate in improvements and quality control in VLE.	80.0	20.0	-
	8. Assessment reports offer a holistic view on VLE performance including all components, programs, and output. They define strengths and weaknesses and improvement strategies.	80.0	20.0	-
	9. VLE assessment depends on input, process, and output with special focus on output quality.	73.3	23.3	3.3
	10. Administration design processes that ensure achieving acceptable standards as well as ensure continuing improvement in performance.	70.0	30.0	-
	11. Presence of a program that studies and analyses VLE and inform senior management staff about the quality of important aspects in VLE.	70.0	26.7	3.3
	12. Availability of important tools such as questionnaires to undertake a survey on quality of VLE parts and components, in a specific time frame for reviews, assessment, and results.	80.0	16.7	3.3
	13. Presence of periodic assessment procedures for VLE (internal and external) for academic accreditation purposes.	70.0	30.0	-
	14. Form Quality Improvement Team with members from different departments to review and improve VLE to ensure quality.	73.3	23.3	3.3

Main Standard	Indicator	Degree of Importance %		
		3	2	1
6. VLE Cost-Effectiveness Standards	1. Find low prices for Internet connection by making use of competition between Internet providing companies.	73.3	23.3	3.3
	2. Increase efficiency and competency of VLE and reduce drop out rate.	73.3	23.3	3.3
	3. The return value of designing and publishing a course is commensurate with the cost.	70.0	26.7	3.3
	4. There is no fee for using virtual courses.	70.0	20.0	10.0
	5. Access to websites and resources related to the course is free.	70.0	20.0	10.0
	6. Possibility to upload free resources and assisting programs that virtual course files needs to operate.	73.3	23.3	3.3
	7. Specialised department take on the responsibility of administrating and supervising the budget and accounts for VLE.	70.0	30.0	-
	8. Form a committee to review laws, regulations, academic, administrative and financial procedures in VLE.	76.7	23.3	-
	9. Availability of accounting and financial system to ensure quality in VLE.	86.7	13.3	-
	10. Extent to which costs and expenses of VLE are equal to those of other Arab and International virtual universities.	80.0	16.7	3.3
	11. Extent to which all components of VLE invest its financial, material, and human resources.	83.3	16.7	-