A TQM based Assessment Framework for Blended Learning Environment in Higher Education Sector

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Abbreviations

The following abbreviations are used in this thesis.

BLE –Blended Learning Environment

DM – Decision Maker

DEMATEL – Decision making Trial and Evaluation Laboratory

EFQM – European Foundation for Quality Management

Eq – Equation

f2f – face-to-face

HEI – Higher Education Institution

HES – Higher Education Sector

ICT – Information Communication Technology

MOORA – Multi Objective Optimization by Ratio Analysis

QDI – Quality Development Initiative

SDV – Standard Deviation

TQM – Total Quality Management

Abstract

The purpose of this research is to develop an assessment framework in the TQM perspective for a blended learning environment in the higher education sector. Blended learning is a specialized field in learning, i.e., combination of face to face learning and e-learning. This research is an attempt to bring a logical approach in assessing the quality feature of the blended learning environment.

The quality of the BLE can be easily enhanced if the implementation of important parameters of quality in the blended learning environment is undertaken at all levels of the institution: individual level, organizational level, and at external stakeholders (employers, government, parents, etc.) level. The six major factors are deduced that affect the quality of the blended learning environment in the HES through exploratory factor analysis. To check the intertwining effects of the derived factors/underlying criteria, the DEMATEL technique is applied. This technique has resulted in the formation of the cause group and effect group out of the derived factors/underlying criteria. This group formation has led to high quality in the BLE.

The criterion, Qualification and experience of the tutor of the cause group, influences the other criteria in the most significant way and is the master influencer. The criterion, appropriate use of delivery methods, is identified as the most related criterion. Furthermore, the ranking of alternatives (by applying the MOORA method) to improve the quality of the cause criteria has resulted in the formation of effective quality implementation strategy in the higher education sector. The use of the EFQM model on cause criteria is once again a step to bring effectiveness in assessment related activities of the BLE and eventually leading to high quality in the HES.

This research involves a mixed method approach to deal with quantitative and qualitative data. The human perceptions and expectations are dealt with by the use of mathematical techniques. A combination of subjectivism and objectivism is seen in the development of this framework. The result of this study has offered a framework to attain superior quality learning environment in the HES.

Chapter 1: Introduction

This research on Blended Learning Environment (BLE) is focused on the quality of BLE. The learning environment is the learning environment which promotes the use of blended learning (a combination of face-to-face and on-line learning). A relationship is tried to be established on the quality based perceptions of BLE by main stakeholders of the learning environment: learner, faculty and employer to enhance the quality of the students' learning experiences and learning outcomes holistically. In particular, this research needs to generate usable evidence about the use of Total Quality Management (TQM) philosophy and tools. In turn, this demands the use of appropriate powerful methodologies. This research is limited to the use of blended learning in higher education sector. Hence the results of this research may or may not be applicable to other BLE. For example: providing training in industrial or government sector.

1.1 Research Background

The Higher Education Sector (HES) has the ability to shape the citizens of tomorrow. In the last two decades technology has influenced all aspects of human life. The way we approached a particular situation or problem in the past is no longer the same approach due to the embracement of technology. One of the biggest influences of technology in our lives is the knowledge industry. In today's world, with the help of technology we have an access to knowledge which is in abundance, and moreover, it is just a "click" away. This has influenced the education field to an extent that courses are designed by keeping technology in mind.

The use of blended learning is increasing in the whole of UK. The use of Virtual Learning Environment (VLE) in Higher Education Institutions (HEIs) have increased exponentially from 7 % in 1997 to 95% in 2005 (Browne and Jenkins, 2003; Joint Information Systems Committee (JISC), 2005).There was a report published in USA named "Going the Distance - Online Education in the United States, 2011" published by the College Board and the Babson Survey Research Group, that stated that there are over 6 million students of which almost one third of the total number of students in USA are taking at least one class online. The important point is that this number is 560,000 students more than the number of students enrolled in 2010. The same report suggested that in 2011, 67 percent of academic professionals were of the opinion that online classes could be equally as effective as face-to-face classes. However, in 2003 only 50 percent had responded this way. This proves that more and more students and educators are comfortable with this kind of reliance on technology and mode of teaching and learning. Exceptions are some courses like sciences, mathematics, humanities, and business studies which are too difficult to be taught effectively in the e-learning environment. Therefore, people from academia have shown a greater interest in blended learning than in the e-learning mode in higher education sector.

Blended learning has overcome the limitations of e-learning or pure online learning. However, the challenges faced by most education institutes in implementing blended learning courses are numerous. The cost of the infrastructure required for the e-learning component of blended learning is quite high initially. At the same time, there are numerous efforts required to redesign the course content to make it electronically suitable and quality wise sustainable for the students and stakeholders respectively. The ICT (information and communication technologies) skills are required to implement and manage e-learning. It is imperative for all stakeholders in the educational institution to understand the existing ICT infrastructure, its services and usefulness in the execution of specific tasks. Moreover, the awareness and adoption of quality development parameters are required. The assessment of quality parameters of this technological advanced environment in total quality management perspective will help in bringing desirable quality learning experiences for learners. Furthermore, the related stakeholders of this environment will also benefit by this development.

1.2 Research Problem

A study in 2006 has mentioned the low status of pedagogic research in higher education (Sharpe et al., 2006).The report has highlighted that all seven institutions under study in UK were finding the establishment of institutional level practices very hard to ensure and enhance the quality of blended learning design in the institutions. It is found that different institutions are using different possible strategic ways to ensure quality at the institutional level. There is no defined way. The absence of a defined way can lead to dissatisfaction, inefficiency, ineffectiveness and non-competitiveness of the learning environment as a whole. This gap is tried to be filled with the help of the adopted approach in this research. According to the report on the impact of networked learning in HEIs

> ‘the evaluation of staff and student experiences appears to be an area that institutions are just beginning to address and one that would benefit from further investigation’(Bricheno et al., 2004, p.7)

Hence the evaluation of staff and student experiences in BLE to improve quality is the strong rationale of introducing this area in this research. Moreover, the extended use of BLE in schools, for primary and secondary education also highlights the importance of superior quality BLE at the level of higher education. This is important to meet the high expectations of learners who are exposed to BLE in schools and are well experienced of learning in such an environment.

The higher education sector, which is no longer strategically confined to the age limit of 17 to 30 years, has openly started accepting an educational paradigm which can provide education to the learners of any age. This sector has opened its doors to a convenient access of high quality education in a more flexible, actively engaged, and reflective way. Learners can fulfill their dreams of a quality learning experience in spite the constraints and commitments of family, money, health, job, etc. there is no doubt that the traditional learning system cannot support this shift. Therefore, the adoption of new learning modes of education in a learning environment has become a necessity for all educational institutions. Blended learning has become a buzz word in today’s learning environment since it promotes not only engagement, access, flexibility in student learning, but it also helps in establishing organizational and institutional imperatives in higher education (Bonk & Graham, 2006).

An interactive, engaging, and flexible learning environment is of the utmost need today. In order to bring excellence to the learning environment, all aspects of the learning environment which means pedagogical, social, technical, organizational, and evaluation and assessment need excellence. There are various success factors and barriers which need to be optimized in order to bring high quality, accountability, and excellence in all these aspects of the learning environment. In today’s world, all learning organizations must make an effort in keeping their environment efficient, effective, and competitive while aspiring for high standards of quality in their outcomes. The success is connected with the outcomes which are further associated with each individual learner’s outcome, professional development of faculty and staff, active involvement in research and innovation, lower drop rate, and high marks in satisfaction in the experience for all stakeholders from the learning environment.

Blended learning is a thoughtful integration of face to face and online learning. The online learning can have asynchronous and synchronous components. The asynchronous mode of online communication allows the participant to think for more time and with an equal right to share their thoughts. The synchronous mode of online learning is comparable with face to face learning in a traditional learning environment. This blended approach is gaining a lot of importance as it provides the best of both worlds. A study by Allen, Seaman, and Garrett revealed that 55 percent of all institutions offer at least one blended course .It seems that in the future the percentage of this kind of college courses will increase, and therefore, the quality of these blended courses and learning environment should be of absolute importance.

The prominence of quality is further manifested by the growing interest in the delivery of high quality services which can often lead to a sustainable competitive advantage (Suresh et al., 2002). Quality management in education has taken varying forms all over the world in terms of stakeholder accountability, customer satisfaction, and issues of assessment, accreditation, ratings, and rankings. The focal point is essentially on the understanding of the stakeholder’s requirements with the resultant objective of delighting them. The educational system comprises various classes of internal stakeholders (faculty and administrative staff) and external stakeholders (students, society, industry and employers).Therefore; it needs to be responsive to the varying and competing interests of all. It is expected that in the future, optimum quality of the BLE will be expected from almost all the HEIs.

The assessment of the quality of a BLE in the TQM perspective for HES will be an important step in the direction of attaining optimality. However, how to do this assessment is a problem? A proper strategy needs to be carefully designed to implement the four necessary elements of quality assessment. The four elements are required to be addressed which are: cost of poor quality, standing in the market place, quality culture in the organization, and operation of a company quality system.

A solution to this problem is proposed in one way by developing an assessment framework in the TQM perspective. The framework takes learners, faculty, and industry representatives and experts to a holistic picture of quality. Hence, the word “Total” of TQM has an utmost importance. This framework addresses all four elements of quality assessment to some extent. The use of decision making techniques and application of sensitivity analysis on the most critical criterion of the blended learning environment has helped in proving the robustness of this framework. A brief of the four major elements of this research, higher education sector, learning environment, blended learning, and total quality management, is given in the next sub section.

1.2.1 Higher Education Sector

The introduction of this research has highlighted the importance of quality in the HES. Higher education means getting a minimum qualification of a bachelor’s degree, higher national diploma, or foundation degrees. Higher education prepares learners to continue their education for the next level towards realizing their dreams, hopes, and aspirations. Attaining of specific knowledge (curricula), attaining of degrees or credentials (careers) and leading responsible lives (civics) are the entities which reflect the beliefs and thoughts of a variety of philosopher/scholars ranging from Plato’s concept of reality to Dewey’s concept of experiential learning. The different existing learning and teaching perspectives, learning styles, learning theories, and learning methods need to be combined together for the formation of a learning environment in the higher education field. The future aim of the HES should be to provide quality education to masses with efficiency so that everyone has the access to a world class quality education.

1.2.2 Learning Environment

In addressing this issue in the higher education field, a detailed study of learning environment would be of great interest. A new mode of learning like blended learning can transform the learning environment in to a desirable quality learning environment. The blended learning environment is studied under different aspects like pedagogical, technical, social, organizational, and evaluation and assessment, in order to get the in depth knowledge of quality parameters. The next step will be to apply the TQM philosophy and quality development tools to create a sustainable quality culture in the learning environment.

1.2.3 Blended Learning

Blended learning is the integration of face to face and online learning. Blended learning has a critical role to play in the global market to prepare the learners to become leaders in their respective areas in the future. Gutierrez (2005) outlines in her research that blended learning is the combination of multiple approaches to learning, combining several delivery methods such as collaboration software, web-based courses, and computer communication practices. Blended learning can successfully make the learning environment more engaging, authentic, meaningful, motivational and reflective. Some studies have underlined that technology and interaction should be taken in consideration in order to design effective, attractive, and efficient learning environments (Karadeniz 2009; Bliuc et al., 2007; Ginns and Ellis 2007). The portable traits like confidence, patience, judgment, and synthetic ability will be a part of the future learner's personality which can be developed with the introduction of problem based learning and generating workplace like simulations. A blended learning environment can help bringing these changes in the HES by creating a student centered environment with improved learning outcomes. The assessment of quality parameters of blended learning environments will be of great importance. The right implementation of the TQM philosophy will develop a sustainable excellent quality learning environment.

1.2.4 Total Quality Management

The TQM philosophy became a part of the higher education institutions by 1980's. It has advocated more than a mere change in the management practice. It promotes quality culture, focus on learner, teamwork, and avid improvement. To make a learning environment driven by this philosophy, all aspects of it (pedagogical, technical, organizational, evaluation and assessment) must be taken into account. The tools, techniques and methods of TQM can contribute in bringing quality, effectiveness, and efficiency in the learning environment. The study's conclusion will present the assessment framework with the objective that all significant factors and criteria are taken into account optimally in establishing and maintaining quality of the learning environment. A detailed study of these factors, criteria, frameworks and assessment methods will be presented in the next few sections of this research.

1.3 Research Aim

To develop a TQM based assessment framework for blended learning environment in higher education sector.

1.4 Research Objectives

The following objectives have been identified to achieve this aim:-

- To identify the relevant literature around higher education sector, learning theories, learning styles, learning methods, blended learning, TQM, and use of TQM assessment tools in higher education sector.
- To determine the important factors and criteria for the quality of BLE in learner's perspective and document them.
- To determine the relationships among factors / criteria in the faculty's perspective and document them.
- To assess the priority of quality development management strategies in the perspective of employer and quality experts.
- To develop a TQM based framework by integrating all the above mentioned perspectives and by applying European Foundation for Quality Management (EFQM) model.
- To refine and validate the framework.

1.5 Research Questions

1. How is the quality of the BLE in HES important for its learners and its associated community?
2. How to develop a TQM based assessment framework in BLE which can help in the improving of the quality of higher education sector?

1.6 Contribution of the Study

This undertaken study will mainly generate the following academic and practical contributions:

1. It provides a comprehensible understanding of the whole situation in the assessment of a BLE in the TQM perspective in the higher education field.

2. This study could be considered a beginning or a background for further studies in the future by other researchers in the field of a BLE.

3. According to the literature review, originally this study might be the first one to deal mathematically with the factors and criteria of a BLE‘s quality in accordance to the different perspectives of learner, faculty, employer and quality experts.

4. This is an attempt to bring a logical approach in the subjective nature of quality related activities which helps in an easy adoption of this approach by HEIs.

5. It helps higher education institutions to analyze the impact of various factors and criteria in maintaining and evaluating the quality standard.

6. It provides a self -assessment framework for higher educational organizations to be able to assess their current quality standards, to identify opportunities for improvement, and to enhance their quality in the future.

7. It recommends steps for quality assessment and enhancement by adopting the suggested framework.

1.7 Thesis Structure

This chapter has briefly explained the rationale for this research by highlighting the importance of the learning environment in the higher education field. The advances in information communication technology have facilitated learning to happen in a tailored made way by taking care of student’s learning preferences in accordance with the learning styles and learning methods. This area of assessment of the BLE in the TQM perspective is identified as being under-researched. The assessment framework will help in developing and maintaining the quality aspect which will help in bringing more accountability, transparency, standardization, and satisfaction in the learning experience. Since this area is being identified as under-researched through the literature review, it is being adopted as a research topic to extend the knowledge in this field. The development of this assessment framework of the BLE in the TQM perspective will follow in the next few chapters.

1.7.1 Chapter 2: Literature Review: This chapter's aim will be to identify and analyze the relevant literature surrounding the higher education sector; learning environment, e-learning environment, and traditional environment. There will be an extensive explanation of various sub topics; i.e., learning theories, learning modes, learning styles, learning methods, learning tools, and assessment frameworks. Moreover, the TQM philosophy and its various tools and techniques will also be reviewed in detail to develop a framework.

1.7.2 Chapter 3: Research Methodology: This chapter will talk about the main philosophical assumptions, the research methods, and the data collection techniques. The exploratory factor analysis and decision making mathematical techniques such as the Decision Making Trial and Evaluation Laboratory (DEMATEL) and the Multi Objective Optimization on the basis of Ratio Analysis (MOORA) are explained in detail in this research. On the basis of the given research setting and the research questions, the appropriate research design, activities, and processes will be decided upon and justified.

1.7.3 Chapter 4: Analysis: This chapter will describe the implementation of the philosophical assumptions, the research methods, and the research tools. A detailed description of data analysis (basic as well as exploratory factor analysis) is given. The results of mathematical decision making techniques the DEMATEL, the MOORA, and the Sensitivity Analysis will be explained in detail with the help of appropriate charts and tables.

1.7.4 Chapter 5: Framework: This chapter will describe the development of framework, and its robustness will be checked through the use of a mathematical technique called: Sensitivity analysis. The application of the EFQM method will help in the development of assessment framework in the TQM perspective.

1.7.5 Chapter 6: Conclusions and Suggestions: This chapter will describe the conclusions and suggestions. These are influenced by the adopted research methods and research questions. This section will also highlight the limitations of the research. The inferences from the findings will be discussed, and future study directions will also be proposed.

Chapter 2: Literature Review

2.1 Introduction

The previous chapter has outlined the problem area and research aim. In this chapter, the related literature will be reviewed. The ubiquitous use of information communication technologies in the HES has brought incredible changes. The main research question, “How to develop a TQM based assessment framework in BLE which can help in the improving of the quality of HES?” is addressed by offering a detailed insight through literature review. This section will review some of the existing literature in the same field. The focus will be specifically on the concept of blended learning, the factors which are important for quality assessment, the concept of TQM, and different existing assessment models related to the learning environment.

The flow chart in Figure 2.1 highlights the flow of the reviewed topics taken as per the research requirement. The first part of this section deals with the importance of the HES in different perspectives: Learner Perspective, Industry Perspective and Government Perspective. The importance of HES is highlighted in this section. Then I reviewed the next main element of HES: learning environment. The HES is explained by dividing it into two main parts. The two main parts are: Learning and Environment. The Learning Theories, Learning Styles and Mode of Learning are reviewed in detail to understand the important elements of quality learning. Next topic which is reviewed is Environment. The blended learning, BLE and TQM are the main topics which are studied in detail in order to get the deep understanding of the aspect of quality in BLE. The application of quality assessment models of TQM will provide a quality learning experience to learners.

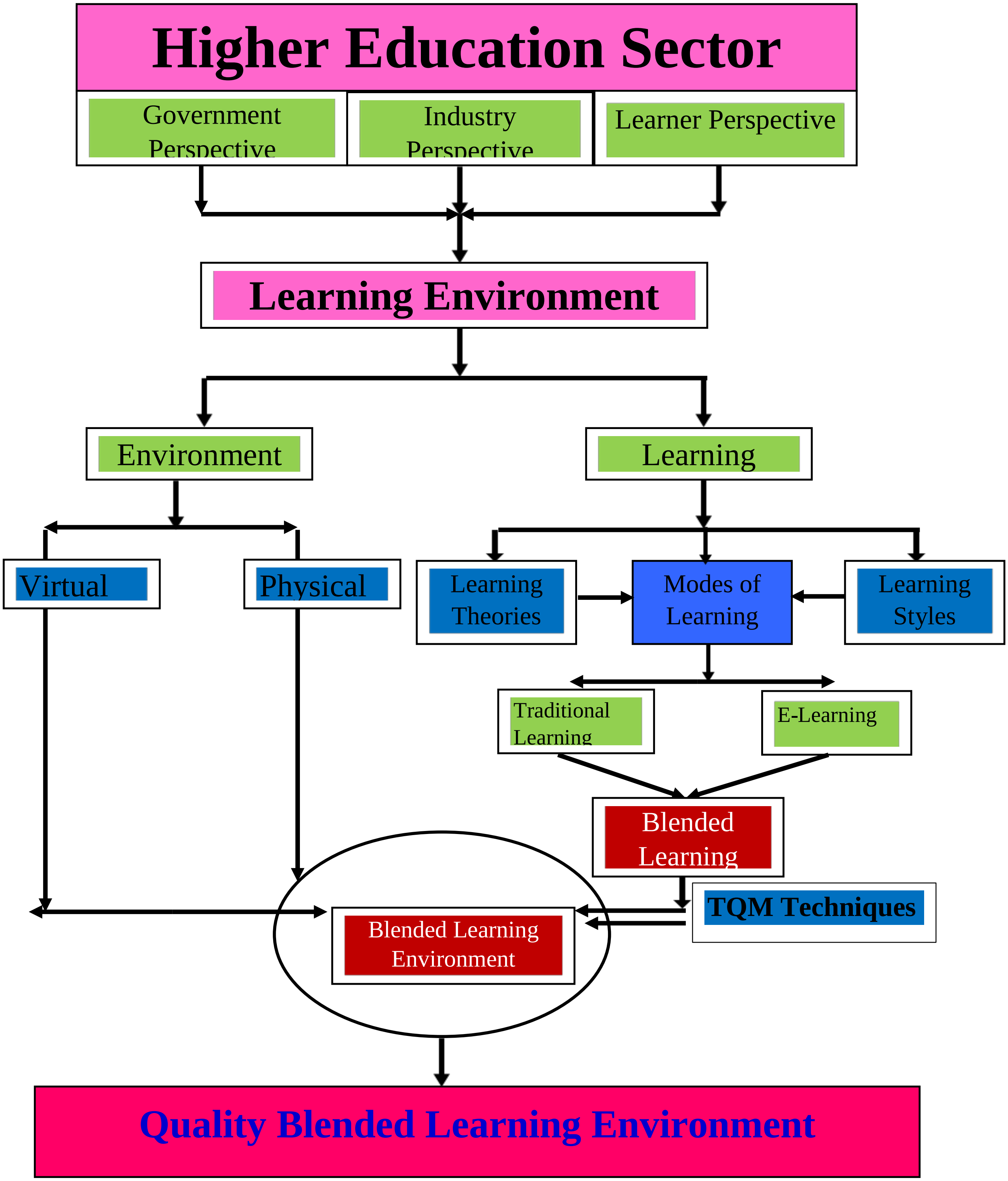


Figure 2.1: Flowchart of various topics in literature review

2.2 Higher Education Sector

The dictionary meaning of education is the act or process of educating or being educated in which the knowledge or skill is obtained or developed by a learning process. The word higher education was first used in 1834, and the meaning of this is referred as the education beyond the level of secondary education. This field is of significant importance because the higher education institutions are not only responsible for the development of skills and abilities of their learners (Ginsberg, 1991), but they also provide learners with quality learning experience for the survival in the global market. In this whole process of development, attainment, maintenance, assessment, and evaluation, a lot of challenges are faced by higher education institutions. The reasons behind these challenges are: the speedy growth of science and technology, the increasing expectation to personalize the learning experiences, the growing demand to reach to more students, the limited financial resources of universities, the rising demand of quality higher education systems, and necessity of more qualitative labor, lifelong learning, and the emergence of the knowledge community.

The higher education institutions are in a continuous search of those delivery methods which will help in achieving the learning outcomes with the best possible outcomes. There is limited access to higher education. The reasons are: High cost, Lack of resources, Lack of tertiary institutions and, Commute problems. The aim of the higher education is to meet the demand of learners for high quality learning so that they can be a part of a qualified workforce. To achieve this, universities and colleges must examine what is happening in their classrooms (Whittington, 2003). The higher education institutions should be ready to produce the kind of environment that promotes critical thinking and problem solving for entry-level employment and beyond. Piaget research has explored cognitive development as a continuum. This continuum has the involvement of four influences: maturation, active experience, social interaction, and general progression.

In today’s world, we are in search of quality of HES that can provide a world class quality education. The importance of HES is reviewed from different perspectives, i.e., learner, industry and government (stakeholder).

2.2.1 Learner Perspective

The various drivers for acquiring higher education from a learner perspective are; acquiring more knowledge, looking for better jobs, acquiring renowned degrees and diplomas, being trained for multinational and multicultural work environments, earning more money, enhancing skills for effective communication , developing leadership skills , and preparing for lifelong learning. Most of the higher education institutions are focusing and adopting learner centric educational paradigms so that the future workforce can be trained in their respective areas of interest to lead and take entrepreneur like challenges in all walks of life.

2.2.2 Industry Perspective

In today's competitive environment, industry wants to hire people with strong academic backgrounds, who are trained in their specialized areas of interest and exhibit leadership qualities. From the industry perspective, job seekers should be able to work within limited resources. Organizations have realized the importance of an efficient workforce to work in the challenging multicultural work environment. The HES aims to set high standards for the future workforce and focuses on training to meet employer high expectations. Skills acquired and nurtured in a learning environment result in bringing more confidence, satisfaction, motivation, enthusiasm for lifelong learning, application of high order problem solving techniques, successful teamwork, competitive work environment, and the initiation of innovative and challenging tasks which lead to the high retention and satisfaction rate of employees in any organization.

2.2.3 Government Perspective

Globalization and providing education to masses are the major areas of focus and concern for the governments all over the world. Globalization is a phenomenon of interconnectedness worldwide which has resulted in bringing changes in the economic, cultural, environmental, and social sectors of society. These changes bring more awareness, competition, and drive to excel in meeting the requirements of established parameters of worldwide standards of work. The internationalization of higher education means either going across borders for education or being admitted to branches of foreign institutions. Providing higher education to maximum number of people can change the outlook of any society. A well-informed and competent workforce helps the nation to overcome social and economic challenges. The high employment rate is a good indicator of economic strength of the government.

In summary, it can be said that the complexities of globalization, educational, and socio-cultural issues have put pressure on the modern HES to make necessary changes in the way teaching and learning takes place. In today's world the role of the HES has become much more demanding in order to cope with these pressures. It is often recommended to revise the roles and educational aims of the higher education institutions in a continuous manner so that these pressures can be dealt with much more efficiency and effectively.

The next section is the most valuable component of the higher education field: the learning environment. This learning environment needs to be developed in such a way so that learners can enhance and polish their existing skills under the expert guidance.

2.3 Learning Environment

A learning environment is an important element of the higher education sector. The learning environment is defined in diverse manners but most precisely, a learning environment facilitates all kinds of learning activities. The learning activities can take place in a more efficient and effective manner when the necessary conditions like proper class arrangement, learning tools, and teaching and learning resources are in place. The learning environment is considered to be made of two parts: environment and learning. The environment is defined in more detail in the next subsection.

2.3.1 Environment

The environment is an integral part of any learning environment. The concept of environment is stated as:

'*The concept of environment, as applied to educational settings, refers to the atmosphere, ambience, tone, or climate that pervades the particular setting*'. (Aldridge et al., 2004, p. 110)

This kind of explanation by Aldridge is so apt for describing the learning environment. The environment is a kind of setting which encourages a welcoming, friendly, and secure atmosphere for achieving the best possible results. No doubt an efficient learning environment is one which facilitates a quality learning experience in higher education institutions. The organizations are emphasizing the importance of continuously improving the learning environment to meet the prevailing global competition from a diverse community of students in higher education institutions.

Moreover, the global competition has helped in establishing the importance of creating a quality learning environment .Therefore, its continuous improvement is the only feasible way to respond to the growing requirements of this sector against the pressures of globalization and internationalization. The European Commission (2009) has also stressed the need for higher education institutions to be challenged to adopt a creative and entrepreneurial approach in acquiring and utilizing knowledge. This kind of attempt can promote innovations in the environment which will enhance the quality of environment. The environment for learning can be of two types: physical environment, i.e., the traditional environment of brick and mortar, or the IT enhanced-virtual environment.

2.3.1.1 Physical Environment

The physical environment has its own vital role in encouraging learning to happen within its premises. Some well-known educational institutions are popular for their architecture, student amenities, campus residential housing, and beautiful surrounding landscape.

The importance of shaping the physical environment is being addressed by (Rothblatt, 2006). The physical environment plays an essential role in the learning experience of a learner since liberal, safe, and healthy environment supports the development of a strong character. Some elite universities are undoubtedly popular for their physical surroundings.

2.3.1.2 Virtual Learning Environment

The virtual learning environment is the one which allows students and teachers to interact in technologically advanced environment in order to facilitate learning. The learning environment can be identified as a learning management system (LMS), a course management system (CMS), a virtual learning environment (VLE), or even a knowledge management system (KMS). Most of the time, these terms are used synonymously, but a few see each term differently. The functionality has increased in the last few years, and recently some virtual learning environments (VLEs) allow integration with other institutional information systems. The examples of VLEs include Blackboard, a commercial development originating in the United States of America, and Moodle, an open source development originating in Australia.

The virtual learning environment is a kind of online environment in which synchronous conversation, asynchronous forum discussions, e-mails, weekly online evaluations, and examinations take place according to learner preference. The virtual environment provides a platform to facilitate all technological advanced learning activities under a variety of aspects. The other vital part of the learning environment focuses on learning. The next section explains the other integral part of the learning environment which focuses only on learning. The higher educational institutions are trying to optimize the learning outcomes by the optimum use of traditional and advanced technological methods. An extensive explanation of it is available in the next section.

2.3.2 Learning

In 1780, Abigail Adams wife of USA President John Adam stated,

"Learning is not attained by chance; it must be sought for with ardor and attended to with diligence"(quotationspage.com http://www.quotationspage.com/quote/3072.html, 2005)

Effective , deep, and reflective learning implies that the learner is not only getting answers to their queries but is also involved in cognitive and constructive problem solving activities in accordance to available knowledge on learning styles, learning theories, and learning methods. Student questions are of utmost importance in the learning process since “questioning lies at the heart of scientific inquiry and meaningful learning” (Chin et al., 2002, p.521).The questioning from learners is also an indication that deep and constructive learning is taking place. Learning can be active or passive in nature. In active learning, a learner is able to retain the knowledge for longer periods as compared to passive learning. The following Table 2.1 by Dale shows it clearly.

Table 2.1 Dale’s cone of experience

Rate of Retention %	Nature of involvement
10	Reading textbook – passive
20	Listening audio files – passive
30	Watching video, still images – passive
50	Participating in interactive animations/simulations – active
70	Collaborative practicing by doing – active
90	Teaching others – active

Table 2.1 shows that reading textbooks, listening audio files, and watching video, all come under the passive learning. In passive learning, the learner can retain a maximum 30% of the content. The other mode of learning is an active mode of learning in which the learner can retain maximum 90% of the new concept. The kind of activities which are a part of active learning are: participating in interactive animations, collaborative practicing by doing, and teaching others. If the concept of teaching others is promoted in the learning environment, then the learner can learn not only actively involved but can help other learners also learn effectively.

So it can be concluded that higher education institutions should build a learning environment where all students, regardless of their backgrounds: 1) are engaged and valued in the classroom learning environment (Macias & Dolan, 2009); 2) should have the access to the learning facilities, resources and students services provided by the learning organizations (Jamieson et al., 2000); 3) are able to participate to build new social networks and join learning communities.

Undoubtedly, the introduction of the right kind of learning theories, learning styles, and learning modes has the potential to optimize the outcomes of learning in the higher education sector. In fact, all these learning theories, learning styles, learning methods, and learning modes constitute the pedagogical aspect of learning environment. The effective adoption of all these elements will be advantageous in bringing the effectiveness and satisfaction to the learning environment. A brief on learning theories, learning styles, and mode of learning is given in the next subsection obtain a more in depth knowledge of these topics.

2.3.2.1 Learning Theories

The evolution of different learning theories in teaching and learning has paved the way to continuously be looking for better quality options. Johann Friedrich Herbart (1776-1841) introduced the first major pedagogic theory, Associations. From Herbart's point of view, there are five steps in the teaching process: preparation (getting ready), presentation, and association (connection of already known with newly learned), generalization (understanding in big perspective) and application (use in practice). Herbart's views were criticized by John Dewey (1859-1952) who was of the opinion that students should learn problem solving skills. In this study, three kinds of learning theories will be explained in brief: Theory of Behaviorism, Cognitive Theory, and Theory of Social Constructivism.

2.3.2.1.1 Theory of Behaviorism

According to behaviorists, knowledge is not an outcome of a mental process. It is an observable outcome and a result of responses to observable stimuli. In behaviorism the stress is given to the hierarchal and sequential way of framing the learning materials. An assessment is considered the only way to evaluate the understanding and ability of learners, and, hence, an extensive use of evaluation and assessment is recommended. The results and feedback are used by the students to assess their performances.

Behaviorism emphasizes teaching and repetition rather than learning. It originated from the Greek word 'didaskein' meaning 'teach'. Behaviorism is often linked to didactic pedagogic beliefs concerned with the instruction of students.

2.3.2.1.2 Cognitive Theory

This is another pedagogical approach which is connected to the mind and related activities. The occurrence of certain behavior is connected with the process of the mind. Under this approach concepts and procedures are analyzed in terms of information structures. In this theory certain influential sub-areas are highlighted, e.g., schema theory, information processing, and theories of problem-solving and reasoning. The basis for such learning is to model the involved processes and then interpret and construct meaning on the basis of previous knowledge and experience.

Increasingly, the cognitive approaches to learning and teaching have emphasized the assumptions of constructivism in building new forms of understanding through activity (Biggs & Tang, 2011).Cognitive theory is based on the thought process .Cognitivists consider learning as a mental process including activities that involve memorizing, thinking, analyzing, abstraction and enthusiasm etc.

2.3.2.1.3 Constructivism Theory

The Constructivism Theory is based on the idea that people construct their own knowledge through their personal experience. Constructivism prepares students for problem solving skills in a complex environment. In Constructivism Theory, the students are more actively engaged in building and creating their knowledge based on their individual and social experiences. As a result, there are differences between the taught knowledge and the learned knowledge based on individual experiences. The teacher is a facilitator who tries to understand how the students interpret knowledge and tries to guide and help them. The guidance is provided to refine the understanding and interpretation, correct any mistaken understandings, and improve learner knowledge quality.

In social constructivism learners construct their own understanding and knowledge during the process of social interactions with others. Vygotsky, the main architect of social constructivism, stated that interaction and help from more knowledgeable peers results in developing more profound comprehension than only the one individual's capacity of learning. The principle of social constructivism promotes the student's deep understanding and creativity (Wink, 2001). Although social constructivism has typically been thought of as a face to face (F2F) mechanism in the traditional learning setting, there is no reason why it cannot take place in other learning environments (Sthapornnanon et al., 2009).

In constructivism, terms like discussion, analysis, investigation, and creation are used extensively in teaching and learning. Learners are motivated in the learning environment to share their interpretations, understandings, and experiences about a topic before it is taught. Communication and interaction are strongly emphasized in this theory. The focus is to create a challenging learning environment for learners. Moreover, the student responses and suggestions are considered to be important in making decisions about teaching methods, instructional tools, activities, teacher assessment, and course materials. The students are given enough time to reflect and construct their own knowledge. Jean Piaget (1896-1980), John Dewey (1859-1952) and Lev Semenovich Vygotsky (1896-1934) are the believers of Constructivism (Shepard, 2000).

In any learning environment the emphasis is on two kinds of interactions: teacher-student and student – student .The teacher-student interactions are examined in the context of conversational methods, and the student-student interactions are examined in the context of the social theories of learning.

Teacher - student interactions: The core of any learning process is comprised of learners and their learning. The teacher's role is to facilitate their learning. The constructivist paradigm was advanced in the 1970's through Conversation Theory. An effective conversation is the base of Conversation Theory.

Few assumptions of the Conversation Theory are:

1) All human beings are learning systems which are continuously engaged in learning activities;
2) Motivation should focus on what is learned and why it is learned.
3) The ability to 'Teach back something', is considered as remembered.

Student – student interaction: In this section student-student communication and the related peer learning elements are discussed. The benefits of group learning are emphasized by the Johari Window, see Figure 2.2

Johari Windows

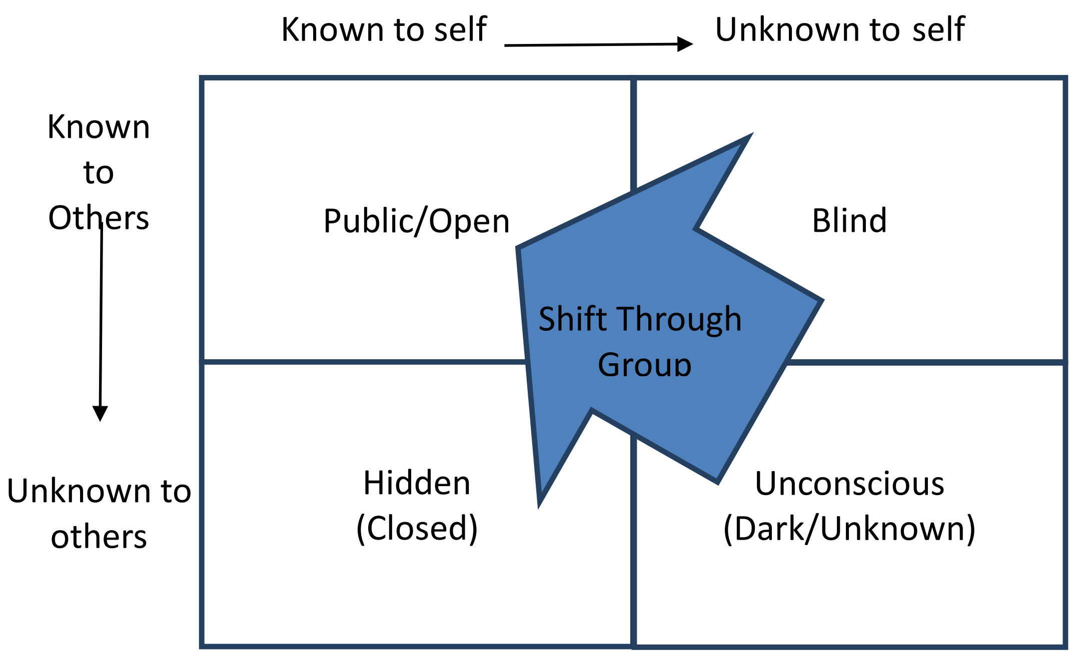


Figure 2.2: Johari Window, adapted after Thurlow (Lengel et al., 2004)

Johari Window in Figure 2.2 is perceived in multiple dimensions. It is ‘Public’ when self and others are aware of it. It is ‘Unconscious’ when it is unknown to self and others. It is ‘Blind’ when only the others can observe it, and it is ‘Hidden’ when it is only known to us. It is believed that collaborative learning helps to achieve a shift of learning to the ‘Public’ quadrant of the window (see arrow in the Figure 2.2 above) by (Heinze, 2008). This model also facilitates enrichment in interpersonal relationships but also self-development .However, some negative effects (unsuitable or dysfunctional outcome) of open communication are also possible.

The other important and relevant social theories are: Zone of Proximal Development and Communities of Practice (CoP).Vygotsky produced the concept of the Zone of Proximal Development and it is defined as:

"…the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers."(Vygotsky, 1935, p.86)

In this concept of ZPD, the emphasis is on enhancing the problem solving skills of individuals, and this is done through interaction with more competent peers. The zone of learning can be treated as the difference between the knowledge of a competent peer and the existing knowledge of the learner.

The concept of Communities of Practice (CoP) was recognized by (Wenger, 1998). It provides an opportunity to establish e-learning communities in educational settings. There are three fundamental elements in CoP. These are:

a) A 'domain' of knowledge (focus for the community outlining a set of issues)

b) A 'community' of people (who are interested in this domain)

c) The shared 'practice' (that they are constructing to be effective in their domain)

The right use of social constructivism and cognitivism in designing the learning activities and processes help in the development of excellent quality learning environment.

2.3.2.2 Learning Styles

A learning style is the method preferred by an individual during the recognition and processing of a specific piece of information (Kolb, 1984). Therefore, a learning style has both an emotional and a mental dimension. Kolb's learning style model states that learning is a combination of experience, cognition, perception, and behavior. In all learning styles, learners use both a process and content approach. The Kolb Model is defined and explained by a four-stage learning cycle. The four stages of this learning cycle are: concrete experience (CE) reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). The concrete experience is followed by reflection on that experience (RO). Reflection on this experience is followed by the development of general rules describing the experience which is called abstract conceptualization (AC). AC may lead to the formation of ways of changing the occurrence of this experience which is called active experimentation (AE).

According to Kolb, the developments of skills in all the four areas are required. The activities were planned to improve the movement along with the cycle. A range of activities related with Kolb's learning styles are written in the following way:

CE **–** group work, seminars, wiki web-site;

RO **–** learning log, bulletin board;

AC **–** presentation, individual assignment, bulletin board; and

AE **–** bulletin board, seminars, wiki web-site

Learners with different learning styles in Kolb's Model can be categorized as; assimilator, accommodator, divergent, and convergent. All kinds of learners use any two of the learning stages only out of four available stages (concrete experience (CE), reflective observation (RO), abstract conceptualization (AC) and active experimentation (AE)). The Figure 2.3 displays all these activities.

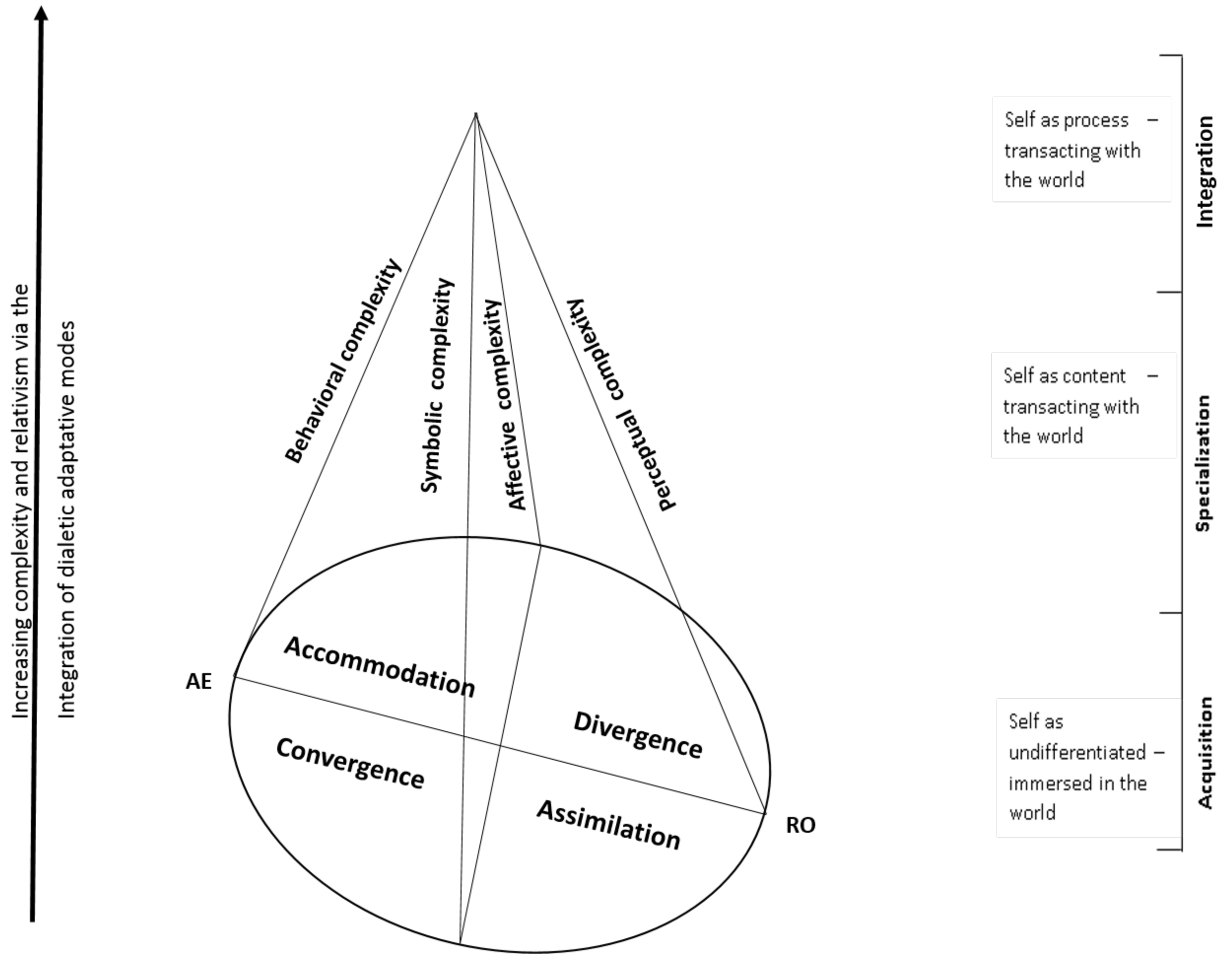


Figure 2.3: Kolb's Learning Styles

According to Kolb, “Learning through experiencing” is suitable for “concrete experience”; “learning through observation” is suitable for “reflective observation”; “learning through thinking” is suitable for “abstract conceptualization” and “learning by doing” is suitable for "active experimentation”. The accommodator learning style includes concrete experience and active experimentation. The individuals preferring this learning style learn by doing and feeling. They like new experiences and planned work. The divergent learners are for individuals with high scores in the areas of concrete experience and reflective observation. These individuals are capable of assessing concrete events from different angles. The assimilator learners use abstract conceptualization and reflective observation. The individuals bearing the characteristics of this type of learner are capable of grasping a large scale of information scattered over a wide discipline and convert it to a logical whole. Instead of dealing with other individuals, they prefer to deal with abstract concepts and issues. The convergent learning style is seen when an individual prefers both abstract conceptualization and active experimentation. Individuals learning in this way are quite successful in terms of the practical application of ideas and theories, solving problems and making decisions.

Kolb's experiential learning theory: According to Kolb, development of learners learning takes shape through four "learning complexities": These are categorized as: effective, perceptual, symbolic and behavioral. In a learning process, "higher-order sentiments" are the resultant of effective complexity in concrete experience; higher-order observations are the resultant of perceptual complexity in reflective observation; higher-order concepts are the resultant of symbolic complexity in abstract conceptualization, and high order actions are the resultant of behavioral complexity in active experimentation.

The developmental process is divided in to three broad stages: acquisition, specialization and integration. (Pedrosa et al., 2004) connected Kolb's learning styles to student questions. According to Kolb's experiential learning theory, questions lie in three categories: acquisition questions, specialization questions, and integration questions. In the acquisition stage, the questions are related to simple facts and concepts. In the middle phase, mainly specialized questions are asked which go beyond the mere search for information. Lastly, in the integration phase, higher-level questions in relation to hypotheses and new applications of knowledge gained are asked.

A relationship has been confirmed between students' questions and Kolb's experiential learning theory (Pedrosa et al., 2004).Blended learning promotes personalization and deep approaches to learning. Through this mode of learning, an attempt can be made to provide answers to different kinds of questions as being asked by different kinds of learners in accordance to their difficulty level (as mentioned in the kolb's experiential learning theory).Moreover, the affordances like small group instruction (in accordance to the need and learning style of learner) and immediate support from the subject matter expert at any time in BLE can help learners to enhance the existing knowledge.

Furthermore, a relationship is being confirmed between approaches to learning which means either surface or deep existing knowledge to relate ideas, patterns and principles and construct new knowledge on the basis of reflection and logic. But the surface approach is related to routine memorization (Entwistle, 2000). Blended learning can be beneficial in promoting deep learning to help learners advance to higher stages of learning with the help of case study approach, group work, discussion forums, and immediate subject matter expert advice .The kolb's model can fit very successfully in the BLE because Kolb states that in order to gain deep knowledge from an experience, the learner must have four abilities:

- The learner must actively and willingly involved in the experience;
- The learner must be capable to reflect on the experience;
- The learner must apply analytical skills to conceptualize the experience; and
- The learner must have decision making and problem solving skills in order to apply on new ideas gained from the experience.

In BLE, the learner is provided with various kind of resources and synchronous mode of immediate help through online experts, text messages and social media which helps in providing deep long life learning experience. The flexibility of BLE enables a learner to reflect on new learning as per the convenience, interest and level of mastery. The new learnt knowledge combined with analytical and decision making skills can be applied in new areas of interest. Such kind of innovative applications in real life helps in making a learner more confident and independent.

Previously mentioned learning theories and learning styles are applicable for any kind of learning environment whether it is a traditional environment or online environment. But in order to get maximum output from the BLE, the learning experience gained through kolb's experiential learning will be more effective in HEIs. HEIs need to develop course content and delivery media by keeping all kinds of learners in mind. The selection of the learning media must be in accordance with student learning styles and mastery level. The next section is a thorough view of the modes of learning available for utilization in the higher education sector.

2.3.2.3 Mode of Learning

The inclusion of different learning methods in a learning environment helps in bringing about more engagement, authenticity, interaction, and reflection. These are required for effective learning in the 21st century learning environment. The two main reasons are: the flexibility of time, place and pace and the personalization of learning processes.

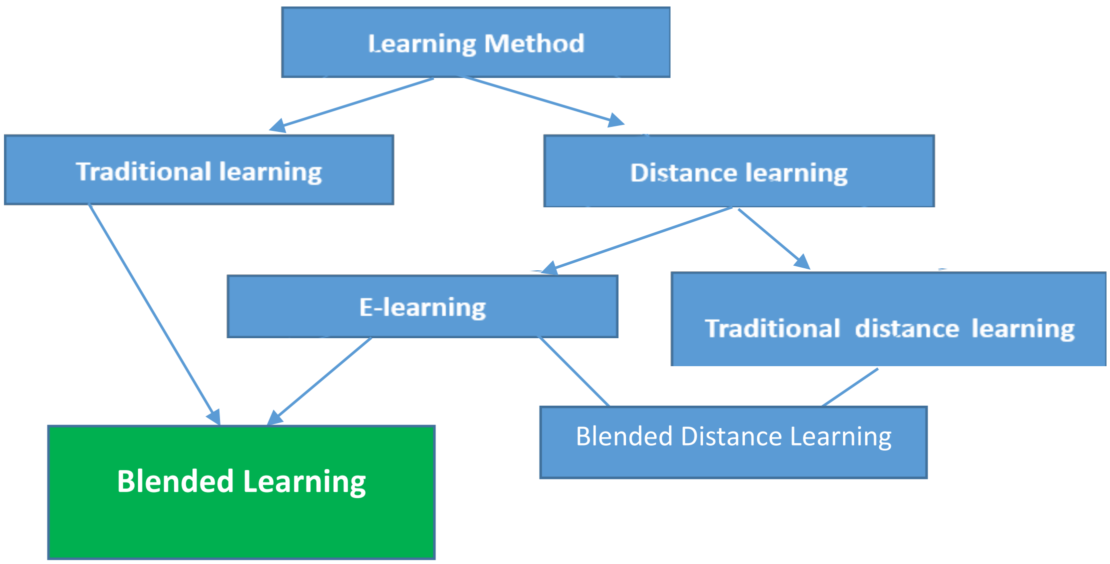


Figure 2.4: Taxonomy of Learning Approaches

There are different kinds of learning methods available which are shown in Figure 2.4. Prominently, there are two main learning methods: traditional learning and distance learning. Distance learning is again divided into e-learning (online learning) and traditional distance learning. According to Figure 2.4, the combination of traditional learning and e-learning is named blended learning. On the other hand, the combination of e-learning and traditional distance learning together is named blended distance learning. The blended distance learning has no physical face to face meeting. This component of meeting in the real world is missing in blended distance learning. The definition of blended learning with physical face to face interaction is going to be taken in this research. This blend of traditional and e-learning is the one which is reviewed and talked about for the development of BLE in this research. The right mix of these components in BLE assures good quality.

The knowledge and understanding of different modes of learning are important to comprehend analytically the deep meaning of quality in the learning environment. From past, the variations, in the nature and requirements of society have brought changes in the modes of learning. To match these requirements optimally, quality is required and hence quality assessment methods also.

2.3.2.3.1 Traditional Learning

Traditional learning occurs typically in the instructor directed face to face environment where the mode of interactions is synchronous and involves a high fidelity factor. The main advantage of this learning method is the prompt feedback which can help a learner to improve without delay. The disadvantage is the nonexistence of the flexibility factor involving time and place. The traditional or face-to-face learning is still popular as a teaching method because most people grew up in a traditional learning environment. The face-to-face learning has some other benefits, such as learning in a social interactive environment which facilitates an exchange of ideas and lowers the possibility of misunderstandings. However, face-to-face learning allows a very limited time for the self-directed learning and student-centered learning. This constraint limits the possibilities for customizing and reflection of the course content according to the individual learner's skills.

2.3.2.3.2 Distance Learning

Distance learning is the learning which usually takes place in a self-paced learning environment. The mode of interactions is asynchronous and involves a low fidelity factor. This kind of learning is preferred by students who have limitation of the time parameter. The belief that students can learn from a teacher who is geographically far from students was conceptualized in 1973 by Moore's theory of independent study (Galusha, 1997). The term "distance learning" gives autonomy to the learner. The communication between the learner and the teacher takes the help of media other than the face-to-face sessions .Distance learning is further divided into two parts: E-learning and traditional distance learning.

2.3.2.3.3 E-Learning

E-learning may be defined as the learning which takes place with the use of ICT methods for teaching and learning (Littlejohn & Pegler 2007). E-learning is strictly accessible through technological tools which means web-based, web-distributed, or web-capable. However, few studies have mentioned the inclusion of audio, videotape, satellite broadcast, and interactive TV, also as a part of e-learning.

In this kind of an arrangement the tutor is physically absent but keeps helping learners using ICT. The educational material is designed thoughtfully in such a manner so that an instructor has minimum involvement in the learner's activities but gives prompt feedback using ICT. In July 2003, the UK government's department for Education and Skills outlined their strategic view on e-learning for the country and has highlighted e-learning for its potential in the process of revolutionizing learning and teaching (DfES, 2003)

The great benefits of e-learning include stimulating interactions between not only learners and instructors but also between learners and learners. Furthermore, these interactions take place regardless of limitations of time and space through the asynchronous and synchronous learning network model (Katz, 2002). Some leading educational institutions have attempted to deliver virtually all of its courses online which signifies the importance of e-learning (Wu et al., 2006).

E-learning has been given synonyms like web-based learning (WBL), Internet-based training (IBT), advanced distributed learning (ADL), web-based instruction (WBI), online learning (OL) and open flexible learning (OFL) (Khan, 2001). Some more vocabularies are introduced as distance learning (DL), open and distance learning (ODL), web based learning (WBL), flexible learning (FL), and network learning in the fourth national conference and the first international conference of e-learning. E-learning takes place in the network environment with the help of multimedia technologies, super media, and tele-communications. The internet is the main reason for the change in e-learning. According to the few experts, the internet is the most important technology to support the modern approaches towards teaching and learning. E-learning is used to disseminate information for education and training.

E-learning is defined by the Instructional Technology Council (ITC) and the National Center for Education Statistics (NCES) as:

"The delivery of educational/training information via electronic media, such as Internet, Intranets, Extranets, satellite broadcast, audio/video tape, interactive TV, and CD-ROM/DVD". (Waits & Lewis, 2003, p.1).

This definition of e-learning is self-explanatory and puts stress on the use of a different delivery media. Rosenberg (2001) has stated that e-learning is based on three fundamental criteria:

- E-learning is networked to be able to diffuse instruction and information.
- E-learning is delivered via ICT.
- E-learning promotes learner-centered activities.

In e-learning, information and communication technologies (ICTs) are used to create experiences that cultivate and support the process of education (Bose, 2003; Davis & Wong, 2007). These information technologies will continue to influence higher education directly or indirectly in the change in the traditional course delivery methods (Rungtusanatham et al., 2004). The traditional delivery methods have to embrace e-learning methods to cater to the needs of today's learners effectively. Furthermore, previous studies have disclosed the failure of pure e-learning courses for the lack of improved student learning.

Pure e-learning has potential drawbacks which have been found by evaluating separately the pure e-learning courses (Riffell & Sibley, 2005; Nemanich et al., 2009) and the mix of traditional and e-learning. The drawbacks are: additional operational cost, lack of face-to-face interaction with instructors and classmates (Carstens & Worsfold, 2000; Yazon et al., 2002), high dropout rates, lack of accountability (Sullivan, 2001), and lack of hands-on activities (Riffell & Sibley, 2005). As an outcome, more college courses have supported ICT use without compromising on the components like learner attendance and the availability of a physical instructor in the classroom.

The word online learning is exclusively used in the places where learning is taking place with the help of internet connection. The online learning methods offer low carbon intensity solutions (Sidney et al., 2010) and hence, are considered the most sustainable solutions for the future. Online learning can enhance the quality of learning experiences and outcomes by servicing a complex and varied community of learners. It is naturally self-reflective, and therefore, it is more beneficial for deep learning.

A greater satisfaction factor in self-learning is observed in the learning environment. These days knowledge sharing by online methods is the requirement of many contemporary workplaces and, hence, has become an essential graduate skill to be taught (Barrie & Ginns, 2007). According to (Castle & Guire, 2010), schools of higher education must try to design premier e-learning courses with a corresponding re-education program for current faculty to prepare and to operate in the new emerging educational paradigm. This is a necessary condition to obtain sustainable education delivery outcomes using the online environment.

The students in higher education prefer online university courses because of the convenience purpose, but still they want a “quality product” that is comparable to traditional campus classes (Costin &Hamilton, 2009; Strang, 2010). Moreover, the cost effectiveness feature of online courses attracts many learners (McLaren, 2004; Schniederjans & Kim, 2005). International data corporation (IDC) expected the value of the e-learning market to be between $21 and $28 billion in 2008 (Liu et al., 2009). According to the reports, the market size of the global e-learning, i.e., distance education and tele learning, will touch USD 49.6 billion in 2014.

"Instruction combining online and face-to-face elements had a larger advantage relative to purely face-to-face instruction than did purely online instruction” (Means et al., 2009, p.17)

Lastly, it can be concluded that both pure face to face and pure online learning are incapable of satisfying the learners if applied alone in the learning environment, but when they are applied together, they bring the desirable results in learning and teaching activities. In the following subsection, the challenges and benefits of e-learning are explained.

2.3.2.3.3.1 Benefits and Challenges of E-learning

E-learning offers the following benefits as compared to traditional instruction (Liaw et al., 2007 & Zhang et al., 2006).

- Provides time and location flexibility—anytime, anywhere availability;
- Lowers the costs and time for educational institutions;
- Fosters self-directed and self-paced learning by enabling learner-centered activities;
- Creates a collaborative learning environment;
- Builds universal communities;
- Allows unlimited access to e-learning materials;
- Allows knowledge to be updated and maintained in a more timely and efficient manner.

Mostly the concept of e-learning is connected with web-based learning, computer-based learning, virtual classrooms, and digital collaboration with another university. All these activities provide an extra advantage for increased accessibility, flexibility, and interactivity through online learning. The learning in a virtual community has relatively low running costs and it is easily available through simple communication equipment i.e., a PC with internet connection, a web camera and microphone.

Although the initial investment for setting up and launching an e-learning environment is quite high, nevertheless, the resultant costs for running e-courses are significantly smaller. Moreover, it results in saving travel, accommodation, and food expenses as well. The main advantage of e-learning is the flexibility parameter which when combines with other benefits, like reduced cost, adoption by large pools of students and fast delivery methods. All these factors make e-learning a desirable method of learning. There are a few disadvantages or barriers to e-learning which include low satisfaction level, lack of interaction, high cost in the infrastructure, computer anxiety, and low motivation (Mackey et al., 2006).

A critical barrier for the restricted use of e-learning is the limited availability of internet and associated resources in some areas of the world. There are two other main challenges for e-learning (Stracke, 2006b):

(1) To ensure interoperability and
(2) To improve the quality

The next subsection explains the e-learning tools which play a significant role in the delivery of e-learning content.

2.3.2.3.3.2 E-Learning Tools: Synchronous and Asynchronous mode of interactions

E-learning tools are subdivided into synchronous and asynchronous interactions. The text-based synchronous interactions are usually brief and can provide instant feedback. Follow up questions can also be asked after that to resolve misunderstandings. The asynchronous interactions do not take place at the same time of happening in reality but such interactions allow more relaxed composition and correction of postings. The synchronous and asynchronous interactions can be defined on the basis of real time responses or the recorded responses. A real time response means getting response without any time gap. The examples of synchronous interactions are online chat rooms, electronic class rooms, and whiteboards. The examples of asynchronous interaction are bulletin boards, discussion forums, and electronic mail. According to Bell and Heinze,

"A common distinction of multi-user electronic interaction that uses the time dimension is between synchronous – same time, e.g. online chat rooms, electronic class rooms, whiteboards, etc. – and asynchronous – different time, e.g. bulletin boards, discussion forums and electronic mail." (Bell & Heinze, 2004, p.20)

These synchronous and asynchronous interactions foster teamwork and collaborative activities which help all learners whether introvert or extrovert to collaborate confidently and actively. Some more benefits of online discussion forums mentioned are improved student-teacher relationship, flexibility, and time for reflection of which is not possible in other learning environments.

The learning environment must facilitate a right combination of synchronous and asynchronous e-learning tools so that learning can take place in deeper, interactive, collaborative, and supported manner for the variety of learners. The main advantage of e-learning is the flexibility parameter which when combined with other benefits like reduced cost, adoption by large group of students and fast delivery methods make e-learning a desirable method of learning.

2.3.2.3.3.2 E-moderation Model

One of the very prominent techniques which focuses on the use of online communication is the 5 Stage Model for e-moderation .This model of teaching and learning online has five-stages in which to engage students with online communication technology. In this model in stage 4, the knowledge construction is the most interactive out of all stages. The development starts from stage 1 and it progresses to stage 5. Each of the stages is further split into two triangles representing the roles of the e-moderator and the technical support staff.

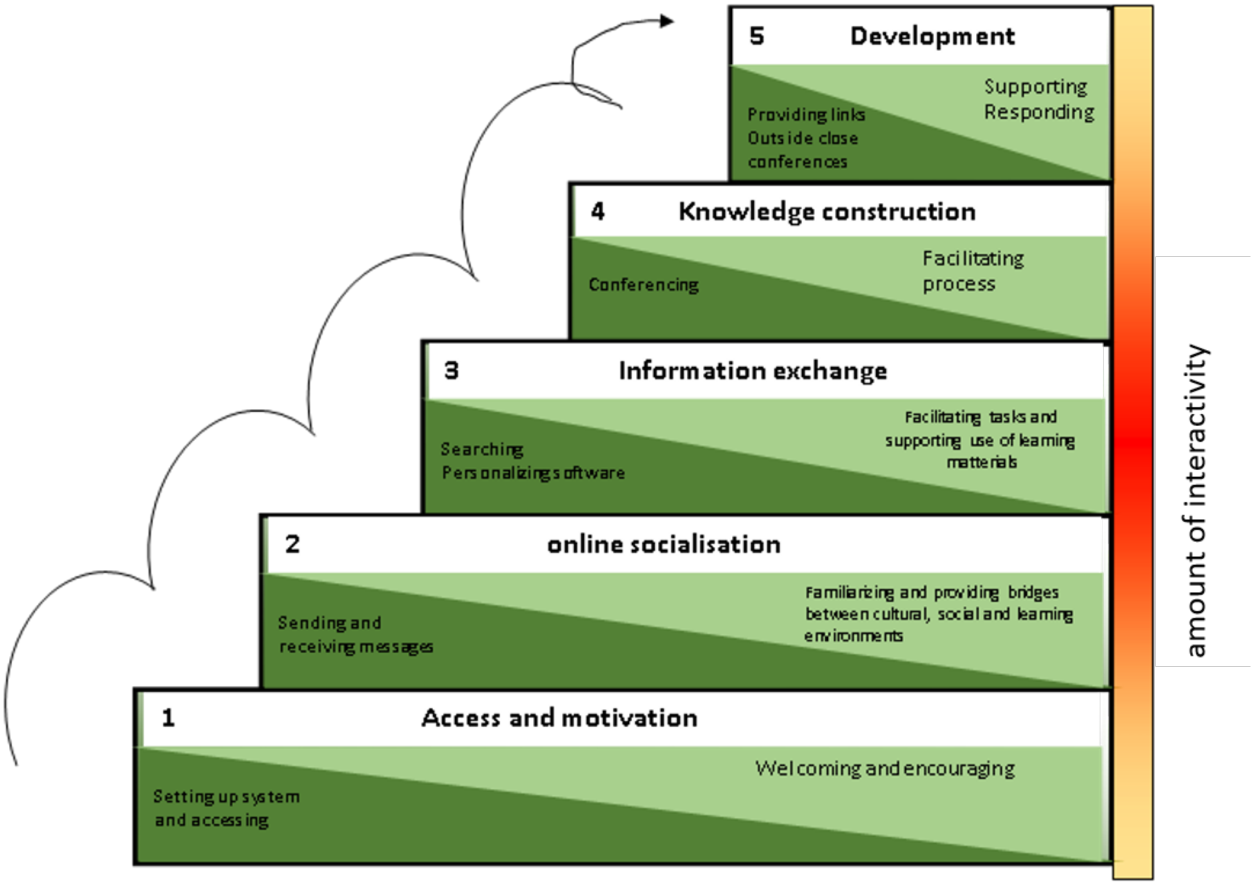


Figure 2.5: Five Stage Model Adapted from Salmon (2004)

This model is very useful when applied in online learning. The next subsection discusses the qualities of the blend of online and traditional learning. The importance of this blend is highlighted in many studies (Osguthorpe & Graham, 2003; Rovai & Jordan, 2004; Garrison & Kanuka, 2004). This mix is defined in an extensive manner in the next section.

2.4 Blended Learning

Blended learning has become a buzz word in education. It is generally defined as the mixing of the strengths of traditional and online learning (Osguthorpe & Graham, 2003; Rovai & Jordan, 2004; Garrison & Kanuka, 2004; Vaughan, 2007; Kim et al., 2009). In a survey, conducted in the HES in North America, Bonk et al. (2006) concluded that around 70 percent of institutions will offer more than 40% of their courses in a blended format after 2013. The reason for this popularity of blended learning is the potential to provide the flexibility and independence which is necessary for the holistic development of the motivated learner.

The whole idea of having such a learning model is to mix the best features of both online learning and the traditional classroom environment. The basic rationale behind the use of the blended learning approach is to create a harmonious balance between face-to-face interaction and online access to information. The blended approach is gaining a lot of popularity as it provides the best of both the worlds of online learning and face-to-face learning. In blended learning the time spent in the classroom is reduced to a great extent and stress is given to active individual learning (Garnham & Kaleta, 2002). The concept of blended learning looks simple and easy to understand, but actually it is much more complicated when it comes to putting it into practice (Garrison & Vaughan, 2008).

In a learner centered conceptualization of blended learning in the higher education institutions, teachers need to control blended learning through the design, facilitation, and support of blended learning experiences (Masie, 2006). There are three main reasons for choosing blended learning: improved pedagogy, increased access, flexibility, and increased cost effectiveness (Graham, 2003). Blended learning is also referred to as hybrid learning or mixed learning (Neumeier, 2005).

Singh and Reed (2001) define blended learning in the following way:

"Blended learning focuses on optimizing achievement of learning objectives by applying the 'right' learning technologies to match the 'right' personal learning style to transfer the 'right' skills to the 'right' person at the 'right' time". (Singh & Reed, 2001, p. 2)

However, Singh and Reed's definition is criticized by Oliver and Trigwell (2005) because the tone of word 'right' sounds as if the control is in teacher's hand as compared to learner, but in reality Singh and Reed's views about blended learning are totally learner oriented. They talk about transferring right skills to the right people at the right time through the right technology. Furthermore, they highlight that achievements can be optimized if the learning styles are also given apt consideration.

Blended learning means mixing of different ingredients like pedagogical approaches, web based technologies, and instructional technologies (Driscoll, 2002).Blended learning is categorized into didactical criteria like skill driven learning, attitude driven learning, and competency driven learning (Valiathan, 2002). Any blended learning arrangement will have three components: content, communication, and construction. A refocusing from teacher to student, from content to experience, and from technologies to pedagogies is being suggested (Oliver & Trigwell, 2005).

Graham (2006) gave a definition of blended learning as a system:

"Blended learning systems combine face-to-face instruction with computer mediated instruction" (Graham, 2006, p. 5).

So, by this definition blended learning systems are designed by mixing the face-to-face instruction with computer mediated instructions, and hence, can be applicable in any learning situation. There should be a proper blend of space, time, media, and activity (Littlejohn & Pegler, 2007) in the following way:

- The space blend: f2f or technology mediated communication
- The time blend: geographically and availability; synchronously or asynchronously
- The media blend: tools, technologies and resources
- The activity blend: learning and teaching activities, individual or group

The importance of the right pedagogy in which learning processes involved are designed to involve learner cognitive skills is emphasized. Blended learning is preferable because blended Learning provides flexibility, independence & responsibility, metacognitive processes necessary for the development of the self-determined learner (Bonk et al., 2006).

The potential of blended learning in providing flexibility and independence is addressed in this definition. Blended learning (BL) is being called an "evolutionary transformation" (Garrison &

Vaughan, 2008) due to the ubiquitous use of web-based systems in universities. In a learner-centered construction of blended learning, the control is with learners rather than teachers (Bonk et al., 2006). “Blended Learning” is the integration of face-to-face learning with web based learning. The proliferation of technology has played a significant role in this context. The traditional learning when combines with technology takes the form of blended learning.

Few studies claim that blended learning is a mixture of 20 to 79% online activities, and the rest is face-to-face activities (Allen et al., 2007). Blended learning has the potential to bring transformation in higher education settings (Garrison and Kanuka, 2004). The blended learning approach has helped universities to meet demands from an increasingly diverse student population and from diverse patterns of educational involvement in the lifelong learning (Hicks et al., 2001).

Blended learning facilitates a community of inquiry effectively. This provides unified influence that balances open communication and limitless access to information on the internet, free and open dialogue, critical debate, negotiation, and agreement by Garrison. A new approach is also seen in the higher education institutions in which the self-managed learning is given immense significance. The blended learning model from a Malaysian university is displayed below in Figure 2.6.

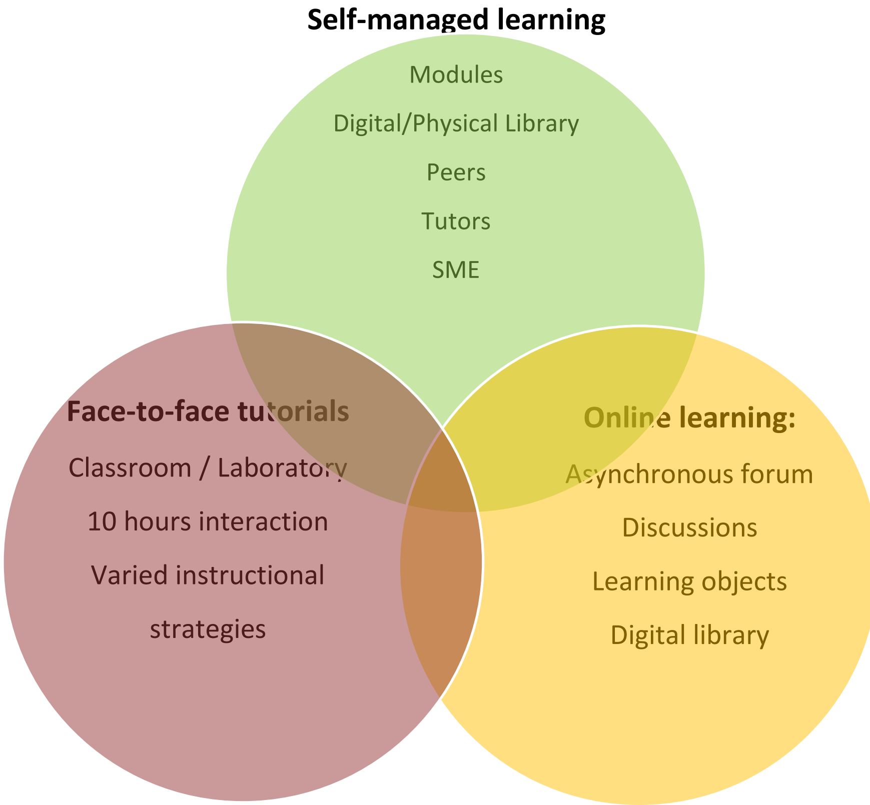


Figure 2.6: Blended Approach in Open Malaysian University (Lim et al., 2011)

This approach of blended learning in Malaysian University has introduced the integration of some variation in the feature of self-managed learning. So, now the self-managed learning is comprised of components like study modules, digital library usage /physical library usage, peers, tutors, and SME (Subject Matter Expert).

Mobile learning is conducted with the help of SMS (text messages) in the learning environment. This mode of learning has an advantage because it gives affordances in the categories like: 1) content, 2) forum/Facebook, 3) tips, 4) motivation, and 5) course management. The BLE can be enhanced with the incorporation of mobile learning (Lim et al., 2011). In the future mobile learning will be gaining a lot more importance.

2.4.1 Success Factors in Adoption of Blended Learning

In a broader way, the affordances and success factors of e- learning and traditional learning are also the affordances and success factors of blended learning. The main affordances are: arousal of the students' interest and participation, flexibility, time conservation in course activities, easy tracking of student progress, improved interaction, collaboration, and communication opportunities. Similar affordances are being mentioned in other related research also. These include improved pedagogy (Aycock et al., 2002; Dziuban et al., 2004), flexibility (Graham, 2006; Palloff & Pratt, 2007), and increased collaboration, communication, and interaction opportunities (Bonk, Kim, & Zeng, 2006; Littlejohn & Pegler, 2007; Osguthorpe & Graham, 2003).

The movement between one environment to another is greatly admired by course instructors (Palloff & Pratt, 2007), due to time conservation and more flexible management of the course requirements (Dziuban et al., 2004; Graham, 2006; Palloff & Pratt, 2007; Rovai & Jordan, 2004). There are also several other affordances like increased cost-effectiveness (Chamberlain et al., 2005), improved retention (Heterick &Twigg, 2003), and improved outcomes (Boyle et al., 2003; Garnham & Kaleta, 2002). The instructor's experience in online teaching and technology use has been suggested as the most valuable element of blended learning. In order to get maximum benefits from blended learning, instructors need to be well trained in the blended learning systems. The flexibility of the instructor is the most sought after quality in online learning (Palloff & Pratt, 2007).

The success factors of blended learning can be related to institutions, teachers, students and pedagogic requirements. The success factors related to institutions are:

1. To develop in accordance to local, community or organisational needs rather than a generic approach (Sharpe et al., 2006).
2. To make sure that institution is showing important building blocks like organisational readiness, sufficient technical resources, motivated faculty, and good communication and feedback channels with students (Tabor, 2007).
3. To provide room to teachers to develop a good understanding about the meaning of blended learning

4. To be introduced in the institution to bring a real reform. It should not be merely an introduction of technology related activities in teaching and learning (Sharpe et al, 2006; Littlejohn and Pegler, 2007; Garrison and Vaughan, 2008)
5. To evaluate and publicize its development regularly
6. To provide continuous professional development for teachers with sufficient time (Vaughan, 2007).
7. To give account to the fact of increased teachers' workloads.
8. To provide ongoing pedagogical and technical support (Garrison and Vaughan, 2008).
9. To put the learners need first, ahead of context (Mason and Rennie, 2006).
10. To understand students' learning maturity and readiness for blending learning (Tabor, 2007).
11. To provide consistent and transparent communication to help students understand the blended learning process (Sharpe et al., 2006).
12. A strong mix of physical and online environment (Garrison and Kanuka, 2004).

Blended learning provides learners with a rich learning context which enables them to increase engagement and achieve their individual goals. Blended learning improves student learning and engagement, improves access and flexibility, and addresses organizational and institutional imperatives in higher education (Bonk, Kim, & Zeng, 2006; George et al., 2010). Blended learning declares that the blended learning course structures promote self-paced learning and the feeling of being an autonomist (Motteram, 2006). Blended learning can be used to assist group work and promote a framework of ''community of inquiry'' to help students learn in more innovative and flexible ways (Garrison and Vaughan, 2008).

2.4.2 Barriers in Adoption of Blended Learning

There are diverse challenges or barriers faced by instructors in the use of blended learning. These are increased time devotion (Dziuban et al., 2004), increased workload (Littlejohn & Pegler, 2007), and deciding on the right blend (Rowley et al., 2002).

In the online system a considerable time for instructors is required (Johnson et al., 2008). This comment contradicts with Garrison and Vaughan's (2008) argument that the careful designing of blended learning can reduce the workload of instructors. No doubt, these are contradicting statements but surely properly designed blended learning is capable of reducing the workload of instructors. The lack of experience can be regarded as a challenge for instructors, which can be a matter of concern for the novice instructors.

2.4.3 Pedagogical Aspect of Blended learning

The pedagogical approach determines and states the instructional approaches. This also specifies strategies to be used and influences the instructor and student roles. Thus, the best pedagogical approach is the one which helps in meeting the most crucial specific needs of the blended course. The achievement and maintenance of harmony between the online and physical environments in terms of enriched interaction, engaged communication, and cooperation among all of the parties also comes under the pedagogical aspect of blended learning.

The Community of Inquiry (CoI) framework was first proposed in 2000 (Garrison et al., 2000). This helps in providing guidance in the complex nature of a blended learning environment. The core of the CoI framework is about deep and meaningful learning. The framework consists of three interdependent structural elements: social, cognitive, and teaching presence.

The social presence offers appropriate climate and interpersonal relationships in the community. The cognitive presence entails a resolution to a problem or dilemma .The resolution is provided through the progressive phases of practical inquiry. A number of models and tools are developed to analyze the cognitive activity and to examine the relationships between interaction and learning.

The teaching presence offers leadership throughout the course of study. When it is possible during the teaching process, use a variety of strategies in the delivery of the content while integrating face-to-face and a variety of innovative technological tools.

The CoI framework promotes deep and meaningful learning. Developing blended learning strategies and multimedia systems promote greater interaction, flexible learner styles and better student-staff communication which are undoubtedly an important pedagogic requirement especially from an international and multi-cultural perspective (Hunaiyyan et al., 2008).

Moreover, in few studies, under the pedagogical aspect, the attempt was made to explore holistically the interactive, collaborative dynamics of the educational experience, and epistemological learning outcomes (Garrison & Arbaugh, 2007) which simply means to explain thoroughly the list of activities, schedule, purpose and mode of activities to achieve the learning outcomes. In reality, the most desirable outcome of any learning and teaching activity is its learning effectiveness and learning outcome. Course design in blended learning needs to be a redesigned structure involving variables like learning content, student engagement, and learning assessments.

Blended learning gives a practical solution for learners and teachers to make learning more independent, useful, and sustainable. As mentioned by several authors the need for purposeful mixing and matching of different learning delivery modes is important (Singh & Reed, 2001; Garrison & Kanuka, 2004; Verkroost et al., 2008). In such settings a substantial amount of the content is delivered online and involves a few face-to-face meetings. But undoubtedly the outcome of blended courses is better than the classroom and online courses (Klein et al., 2006).

The human factor (learner, faculty) is one of the most prominent factors of the pedagogical aspect of blended learning (Ozkan et al., 2009; Schreurs 2008; Graham, 2006; Badrul, 2005). In a traditional higher education, the focus is always on lectures and assessments .In fact, both community of scholars and inquiry are ideal for the construction of deep and meaningful knowledge (Ramsden, 2003).

A study from Swan et al. (2009), agrees with the idea of the promotion of social constructivism and on techniques that are at the center of the learning process within an effective university environment. The importance of infrastructure is highlighted by same scholars who have mentioned human factor earlier.

The role of an instructor is very significant in blended learning since the ‘instructor’ is the main contributor to e-learning and the traditional learning. The previous studies state that the instructor’s attitudes towards technology, their teaching styles, and their control over the technology influence the learning outcomes. Learner characteristics such as motivation, confidence, computer anxiety, fear, anxiety, apprehension, enthusiasm, excitement, pride, and embarrassment need to be identified. Several researchers considered a learner’s perceived effectiveness as an important indicator of an effective learning management system (Liaw et al., 2007; Holsapple & Lee-Post, 2006; Selim, 2007; Sun et al., 2008).

Some researchers proposed that user satisfaction is the most appropriate measure for the success of an information system. Previously, it was found that the most powerful indicator of a learner's attitude is the 'learner's perceived enjoyment towards the e-learning system. The support factor in education services is considered to be a success factor (Graham, 2006; Schreurs 2008; Ozkan et al., 2009).

The clarity of the pedagogical targets improves the interest and participation of students. Engagement can be expressed as:

"A coming together, a merging, a fusing. Engagement points to mutual listening, to reciprocity, to dialogue, but conducted in a willingness to change" (Barnett, 2003, p.253)

The aim of the higher education is to meet the demand for high quality students to enter the workforce. Then universities and colleges must examine what is happening in their classrooms (Whittington, 2003), and be ready to produce the kind of environment that promotes critical thinking and problem solving for entry-level employment and beyond.

To ensure student interest (making learning a pleasure and providing skilled explanation) is the first principle of effective teaching (Ramsden, 1992). Ramsden's second principle of effective teaching in universities is to show concern and respect for the students and student learning. It is considered obligatory for good teaching, and therefore, necessary for effective learning. The third principle of good teaching is to provide suitable assessment and feedback. Ramsden comments that for students all the facets of good teaching are important to them, feedback on assessed work is perhaps the most commonly mentioned .Ramsden's fifth principle stresses the creation of a learning environment that encourages independence, control, and active engagement. The foundation for this principle is in the support of cooperative learning over competitive and individualistic learning.

Providing formative feedback to students about their online learning is of immense importance. In today's society, in the academic environment the concept of efficient learning has an important element called" time". The concept of "time" in teaching efficiently has become sensitive and value-laden (Salmon, 2000). According to Damoense:

"Teaching online is more demanding than traditional face-to-face" (Damoense, 2003, p. 5)

Change to this teaching online can be much more demanding than f2f for few subjects and courses. The next subsection describes the technical aspect of blended learning.

2.4.4 Technical Aspect of Blended learning

The efficient technical infrastructure is the basis of successful blended learning. In this context, the virtual part of the learning has to be of high quality. Moreover, users need to be thoroughly competent in the area. There are few other studies also which have supported the importance of technical infrastructure as an important factor (Badrul, 2005; Graham 2006; Swedish Agency 2008; Ozkan et al., 2009).

There are technical parameters such as system quality and internet quality that have a remarkable effect on the effectiveness of a learning management system (Holsapple & Lee-Post, 2006; Kim & Lee, 2007; Liaw et al., 2007; Selim, 2007; Sun et al., 2008).Usually system quality has two parts: the learning management and system software and the peripherals, i.e., the hardware. The software quality covers stability, security, reliability, pace, responsiveness, ease of use, user-friendliness, well-organized design, and personalization (Shee & Wang, 2008).

The quality of the peripherals signifies functionality of the microphones, earphones, electronic blackboards, electronic mail, online threaded discussion boards, synchronous chat, and desktop videoconferencing. The availability of broadband connection 24/7 helps in improving the quality of learning. The adequate support in the form of the provision of e-library, online orientation services, and availability of online experts enable the learner to achieve their learning outcomes in the best possible way.

Moreover, the features like reuse of content, reuse of resources and the use of latest technology (like cloud) can successfully bring about the sustainability feature in creating, maintaining, and sharing resources in a cost effective and efficient way. The learning quantity and quality suffers when learners are exclusively and completely immersed in technology-based instructional delivery methods. The reason for such a learning decline (quality and quantity) is the absence of human interaction (Laurillard, 1993), failure in adjusting to the new technology tools, delayed feedback, procrastination in learning (Lim, 2002), and less motivation to read online learning materials (Lim & Kim, 2003).

2.4.5 Social Aspect of Blended Learning

A learning community is the one in which members interact with each other and try to achieve their targets by exchanging their views and efforts. Improved interaction between members results into a more effective learning experience. The engagement and involvement of members are crucial points for the successful operation of the community and finding out problem areas. Social media like Facebook and Twitter are being used by the prospective students to contact current students or alumni to obtain a more authentic, well-rounded view of the institution.

The student-lecturer, student-student, and student-content interaction processes are important from the perception of attaining the learning objective. The effectiveness of interaction in the blended learning environment motivates the learners. The performance of motivated students is better than unmotivated students. In the assessment of online learning motivation, six learning motivation variables are: reinforcement, course relevance, interest, self-efficacy, affect, and learner control (Lim & Kim, 2003).

The students recognize the value and importance of group work and interaction activities for knowledge construction and learning. The collaboration among various universities from all over the world exposes the learners to international experiences. This kind of experience can really be significant. These days, the use of cloud services is prevalent in collaborative activities which supports the low intensity carbon production process.

The absence of meaningful face-to-face social interaction may even hamper the entire online learning process (Bonk and Graham, 2005). Learners of solely online courses usually can feel reluctant, frustrated, and dissatisfied with the virtual collaborative learning methods. This kind of feeling further develops into feelings of isolation. The absence of verbal and facial cues (human absence) impede the process of deep learning (Kirkley & Kirkley, 2005). The cultural factor is an important success factor socially (Graham, 2006; Khan, 2005). This implies that the application of the quality concept in this aspect of blended learning can enhance the student's satisfaction level.

2.4.6 Organizational Aspect of Blended Learning

The continuum of blended learning is explained in a detailed in Figure 2.7 by Jones (2006). It states that at the organizational level, all institutions must try to establish a continuum of blended learning. They should move from the basic ICT usage to e-enhanced, then from e-enhanced to e-focused, and lastly, from e-focused to e-intensive. The example for basic kind of ICT usage is power point presentations. In the e-enhanced stage, learners and faculty members have an access to online resources. The E-focussed have access to discussion boards and interactive materials. Lastly in E-intensive course, the whole module is delivered online.

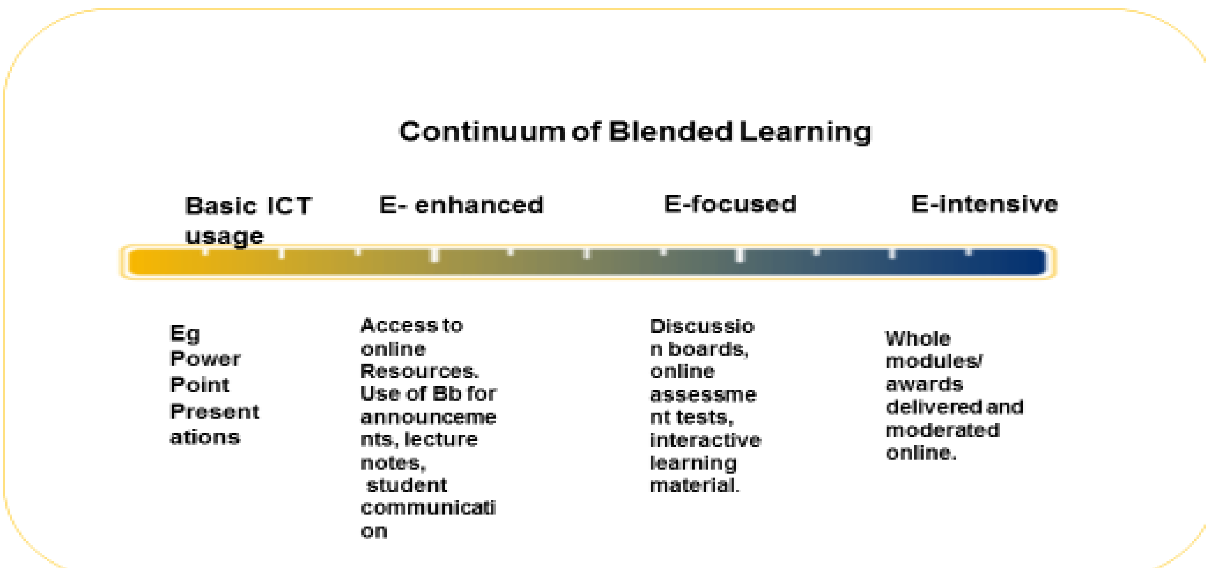


Figure 2.7: Continuum of blended learning is explained by (Jones, 2006)

Blended learning continuum is displayed in Figure 2.7and is given by Jones. The continuum is modified by providing the additional information in terms of proportion of content delivered online and type of course (Allen et al., 2007).The modified continuum is shown in Figure 2.8. The proportion of content delivered online varies from 0 % to 80%. The course is named as traditional if 0% course is delivered online. However, the course is named as web-facilitated if the proportion of content delivered online is in the range of 0 % to 29%. Moreover, the course is named as blended /hybrid if the proportion of content delivered online lies in the range of 30% to 79%. Online courses are the ones in which the proportion of content delivered online is 80 % or more.

Proportion of Content Delivered Online	Type of Course	Typical Description	Jones' Continuum
0%	Traditional	Course with no online technology used – content is delivered in writing orally.	Basic ICT usage
1 to 29%	Web Facilitated	Course which uses web-based technology to facilitate what is essentially a f2f course. Uses a course management system (CMS) or web pages to post the syllabus and assignments for example.	E-enhanced
30 to 79%	Blended / Hybrid	Course that blends online and f2f delivery. Substantial proportion of the content is delivered online, typically uses online discussions, and has some f2f meetings.	E-focused
80+%	Online	A course where most or all of the content is delivered online. Typically have no f2f meeting.	E-intensive

Figure 2.8: Indications for Blended Learning Continuum (Allen et al., 2007)

This retention rate will be further improved in cases where the educational institutions award an authoritative degree for their courses. In the next subsection the assessment and evaluation factors are considered from the quality aspect.

2.4.7 Assessment and Evaluation Aspect of Blended Learning

Assessment is an expected outcome of all teaching and learning practices in higher education (Sadler, 2005). Earlier the assessment activities were meant to satisfy only the bureaucratic requirements of universities but now for learning and teaching also. The initiatives to promote learning-oriented assessment are being observed clearly in tertiary courses (Rovai, 2004).

Prompt and continuous feedback is an important feature of learning oriented assessment. Online communications promote more interactive assessments; often based on collaboration and participation. Synchronous Cyber Assessment (SCA) encourages distinct methods of group dynamics, through simulations, virtual seminars and synchronous group work. The students can communicate their knowledge by text messages, digital productions, oral presentations, and group discussions (Leone et al., 2010; Micu et al., 2012)). However, there are some challenges also, i.e., problem of security, accessibility, and identification.

The SCA can be formal, semi-formal, and informal. The formal assessment usually means on campus, and hence, easily identifiable, but inflexible in time and location with additional costs. The semi-formal assessments can be conducted away from the university settings with additional costs. The informal assessment means anywhere in location with low costs for students but also inflexible in time. The peer and self-assessments are crucial for learner practice in a Synchronous Cyber Classroom (SCC). The learner's view of the investment made by him/her in making the choice of selecting the blended learning course should be positive. The positive value of this return on investments means the learner believes that an option of this kind of learning environment has benefitted him positively cost wise.

Blended learning is a meaningful way to engage students and also enhance their skills for decision making, reflection, self-direction, and self-regulation. All these skills are absolutely a must for making a learner a self-motivated learner. In the next subsection, framework of blended learning communities is explained.

2.4.8 Framework for Blended Learning Communities

In a framework for the quality assurance of blended e-learning communities by (Varlamis & Apostolakis, 2010), a set of criteria for the evaluation of the educational process in blended e-learning communities are considered. The involvement of quality assurance helps in meeting the quality standards for evaluating the expected outcomes. In this assessment framework in Figure 2.9 the pedagogical, technical, and social aspects of blended e-learning communities are considered.

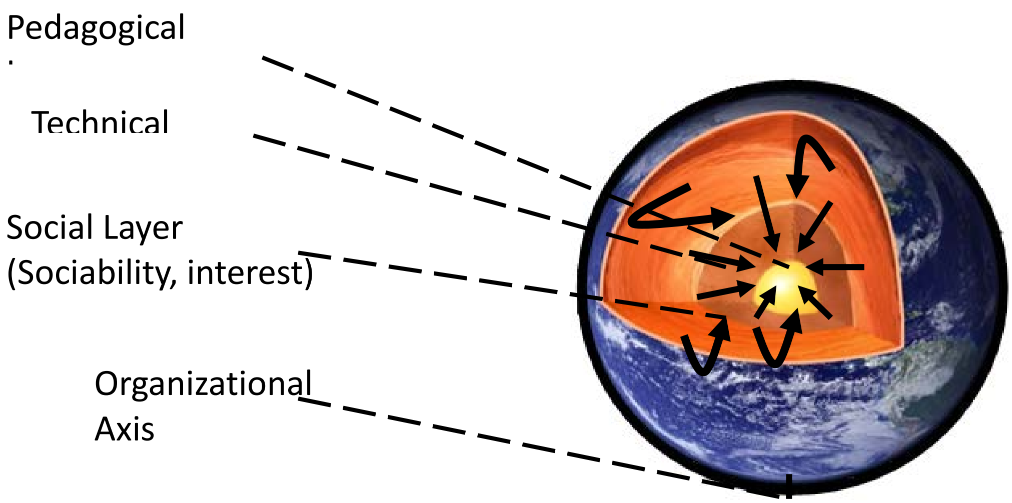


Figure 2.9: A Metaphor of Learning Community (Varlamis & Apostolakis, 2010)

The pedagogical layer covers the quality of the learning process. These processes are strongly related to pedagogical targets. The clarity of these targets helps participants to perform according to their interest, convenience, and schedule. The technical infrastructure is concerned with the virtual part of the learning community. The quality assurance of technical components of virtual learning environment is highly important. The assurance brings more reliability and satisfaction. The social layer covers all parts of pedagogical and technical layers. This layer is influenced by the interest of learners and culture of related social structure. The organization moves around the axis by making sure that all these layers are well taken care of.

The educational experts agree that e-learning alone cannot give complete satisfaction to the learner, and therefore, an educational paradigm is required which has the strengths of both the worlds of online learning and face-to-face learning. This kind of arrangement comes under blended learning, mix of e- learning, and traditional learning. This arrangement is explained in the next section.

2.5 Blended Learning Environment

A learning environment which supports blended learning will be called a blended learning environment. The blended learning environment is a combination of a physical environment and an IT enhanced (virtual) environment. The blended learning environment is one in which most of the learning activities are conducted online, and the time spent in the traditional classroom environment has been reduced but not totally removed (Garnham & Kaleta, 2002).

The blended learning environment provides the best mix of different learning strategies which makes it more effective and successful than other learning environments. According to Martyn (2003), a successful blended learning environment involves face-to-face interaction in the classroom, synchronous conversation, asynchronous forum discussions, e-mails, weekly online evaluations, and examinations. Thus, an interactive, engaging, and flexible learning environment is needed.

The BLE should contain the dynamic course contents, videos, animations, an announcement page for the purpose of communication and correspondence, a calendar page to monitor the course program and objectives, a synchronous chat page that will provide online communication and interaction, synchronous and asynchronous discussion forums, course materials, a virtual agent, and informative links (Demirer & Sahin, 2012).

A BLE can enhance learning in the HES by creating an enhanced student centered environment as well as improved learning outcomes. The assessment of the quality standards of these blended learning environments will be of great interest. The importance of the BLE in the future is highlighted in Figure 2.10.

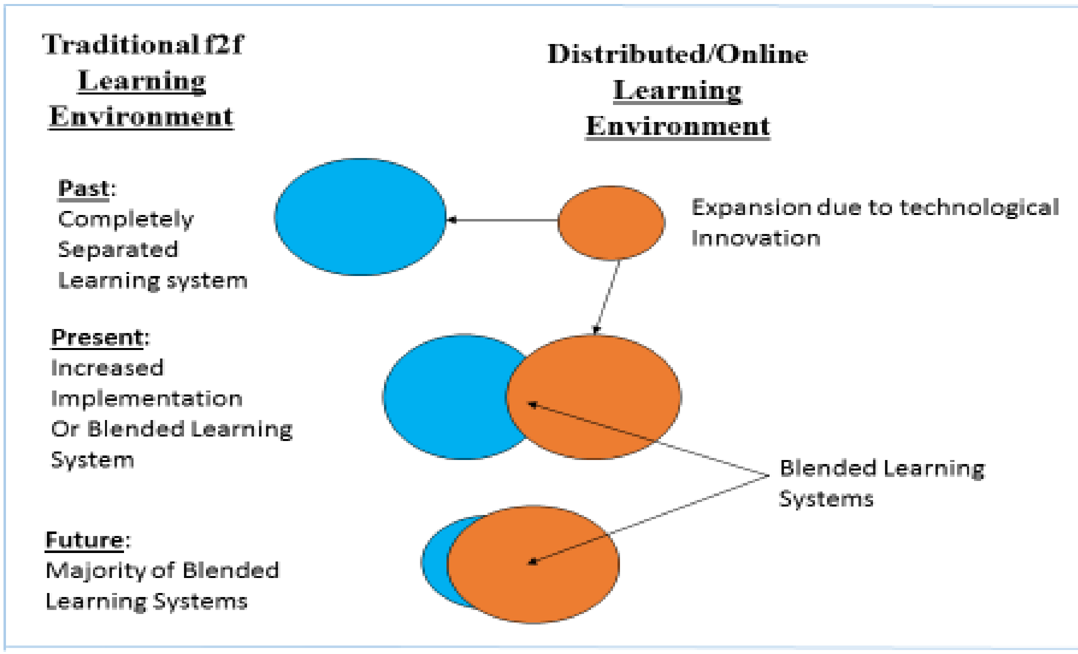


Figure 2.10: The Handbook of Blended Learning by (Bonk & Graham, 2005)

Figure 2.10 depicts the transition from past to future in the use of traditional learning environments and online learning environments. In the past, both were completely separate systems. Presently, there is an increased implementation of blended learning systems. Furthermore, in the future it is predicted that online learning environments will overshadow the traditional face-to-face learning environment.

The teaching and learning processes have been redesigned to develop an authentic blended learning environment that provides students real-life learning experiences supported by new technologies (Smith & Parker, 2012). One key challenge is to identify how to construct more flexible, interactive, and engaging student-centered environments that can support students as they "transition to the workplace".

Blended learning environments should incorporate four key learning principles: relevance (Murphy, 1997; Huang, 2001), authenticity (Herrington et al., 2007), interaction (Cheetham & Chivers, 2001; Laurillard, 2002), and reflection (Boud et al., 2006).

Authentic learning environments are not content driven but are process driven which enables students to complete complex real-world tasks over a period of time in collaboration with others they would in a real workplace. It encourages confidence and cultivates "portable skills" such as judgment, patience, synthetic ability, and flexibility that most learners have difficulty in grasping (Lombardi, 2007). Educators view "authentic learning" from a variety of different perspectives. More exposure towards the authentic communities of learning, the better prepared they will be to deal with "the messiness of real-life decision making" (Lombardi, 2007, p. 3).

Authentic learning tasks that require students to use technology as cognitive tools to seek information, construct knowledge, communicate, and collaborate effectively have the potential to improve student engagement and outcomes (Herrington et al., 2006). In the online environment, the asynchronous computer-mediated conferencing supports flexibility, reflection, interpersonal and teamwork skill development, motivation, and collaboration in learning environments (Heterick & Twigg, 2003). Tailor made blended models can add value in a student's learning process. Instructional structure and interaction are success factors for effective e-environments (Liaw, 2007).

For evaluating the higher-order learning, the PI (Practical Inquiry) model is of significance. Schrire found the importance of the PI model:

'*to be the most relevant to the analysis of the cognitive dimension and represents a clear picture of the knowledge-building processes occurring in online discussion'* .(Schrire , 2004 , p. 491)

Practical inquiry has got a great relevance in the analysis of cognitive dimension and in online discussions. Blended learning cultivates "portable skills" such as judgment, patience, synthetic ability, and flexibility which most learners have difficulty in grasping (Lombardi, 2007). Authentic learning tasks are a combination of the right blend of face-to-face and online activities. These learning tasks help students to use technology as cognitive tools. Authentic tasks are the ones that encourage and support student involvement and captivation in a cognitive real environment. These tasks facilitate self-directed and independent learning.

2.5.1 Design of Blended Learning Environment

The authentic tasks that encourage and support student engagement. The immersion in a cognitive real environment can facilitate self-directed and independent learning. These tasks are facilitated with the help of different blended learning settings and design. For example, Driscoll (2002) has pointed out that in some settings blended learning can have different meanings. It can mean:

- The combination of different web-based technologies;
- The combination of different pedagogical approaches;
- The combination of any form of instructional technology with face to face instructor-led training;
- The combination of instructional technology with actual job tasks in order to improve the process of transfer of learning.

The three components of the design of blended learning: content, community, and collaboration are highlighted (Schneider et al., 2002). According to the media synchronicity theory, there are two fundamental communication processes: conveyance and convergence. The synchronous settings are more suitable for developing shared understanding (convergence), whereas asynchronous settings are more suitable for the exchange of information (conveyance).

The issue of cost related activities in choosing a delivery format is being addressed (Kerres & Witt, 2003). The use of different communication options needs to be taken into account quite carefully. The costs which are mainly involved in maintaining a physical and VLE are the setup, operating, and maintenance cost.

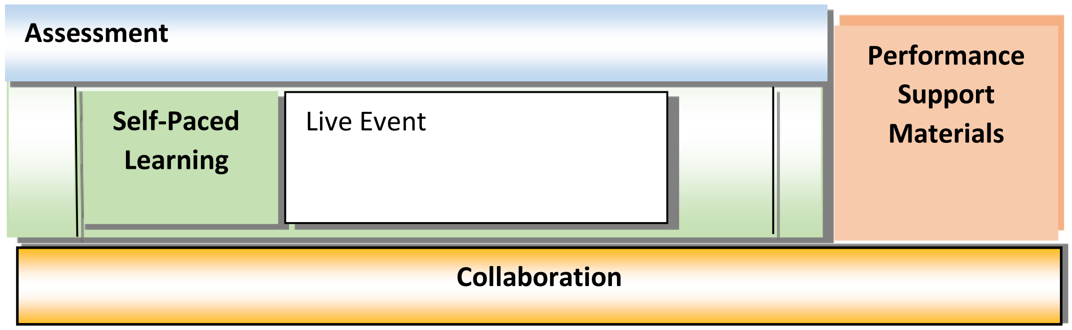


Figure 2.11: Five Key Elements in the Blended Learning Design (Carman, 2002)

Five key elements emerge as the foundation of blended learning design as shown in Figure 2.11. The five major elements are: (1) *Live Events*: Synchronous, instructor-led learning events in which all learners participate in real time, such as face-to-face or in a virtual classroom, (2) *Self-Paced Learning*: The individualized , mastery based learning that the learner completely takes his own decision to complete at his own speed as per the availability of time and resources, such as interactive, Internet-based or CD-ROM training, (3) *Collaboration*: An activity in which learners communicate with others; for example, e-mail, threaded discussions or online chat through an available medium like LMS, social media like Facebook, or Twitter; (4) *Assessment*: A simple way to assess the learners' knowledge. The assessments can be of different kinds. For example, pre-assessments, on the spot, and post-assessments follow live or self-paced learning events to measure learning transfer, and (5) *Performance Support Materials*: Performance material can be reference materials including PDA downloads, printable references, summaries, and job aids .

Blended learning environments provide the independence and control which is required for the development of critical learning (Farley et al., 2011).The interactions which are peer-to-peer, student–content, student–teacher, teacher–teacher, teacher–content, and content–content are facilitated and encouraged in blended learning models (Anderson, 2008).

In the twenty-first century, where e-learning is rooted in personalized interactive and mobile learning in universities, the use of social media and Open Educational Resources (OER) is emphasized in a significant manner. A design of a BLE for future is given by (Gedik et al, 2013) in Figure 2.12. This model explains the critical issues in designing the blended learning courses.

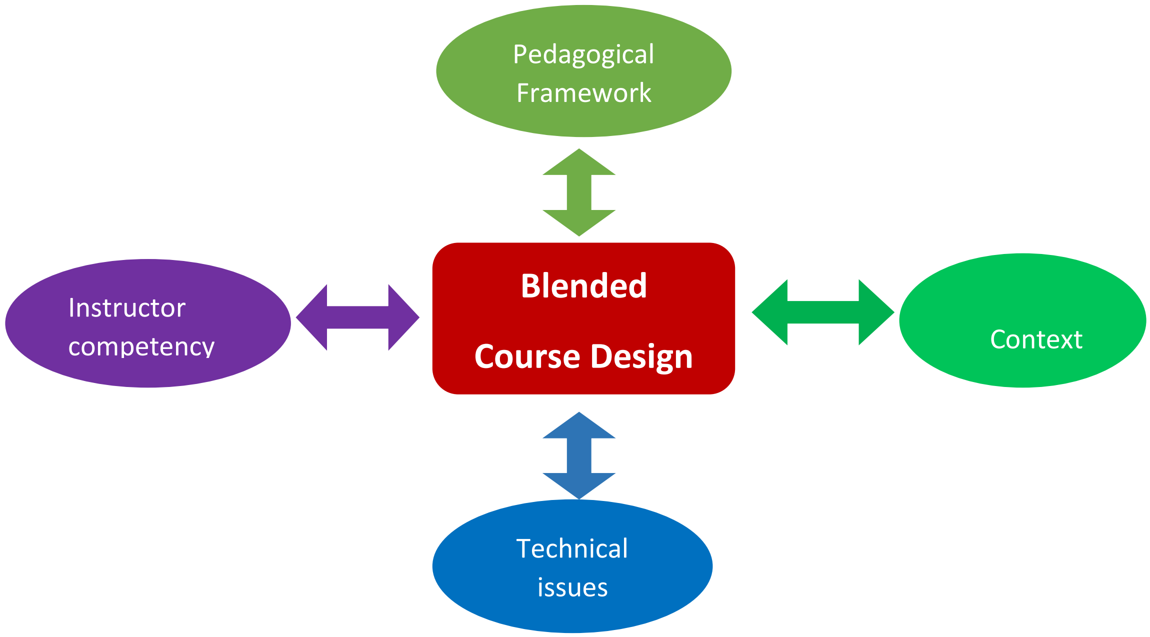


Figure 2.12: Critical Issues in the Blended Learning Design

These critical issues are pedagogical framework, instructor's competency, context, and technical issues. The instructor's competency to encourage deep learning is highlighted in this framework in Figure 2.12. Moreover, the role of appropriate context which promotes the cognitive abilities of learners is being mentioned as a vital component in designing the learning environment. Finally, the technical issues in the designing of a BLE are considered to be of great importance. The technical availability, usability, and maintenance of the online environment are considered invaluable in the design of future blended learning environments.

In today's world, higher education organizations are ready to meet their students' growing needs and ever-increasing expectations to provide high quality learning experiences and results. For that, the organizations are continuously adopting new measurable approaches with better synergy and targeted goals to improve student academic achievements, transfer of learning, and performance (Singh & Reed, 2001). The extensive use of advanced technology in the learning environment is predicted in the future. Thus, the design of the blended learning environment needs to be effective.

2.5.2 Success factors of Blended Learning Environment

The previous research has indicated that both quantity and quality of learning suffer immensely if the blended learning environment is not designed by incorporating the success factors. Furthermore, to some extent the success factors of the blended learning environment are the same as the success factors of blended learning. The success factors of the learning environment can be divided into the pedagogical aspect, technical aspect, social aspect, organizational aspect, and the evaluation and assessment aspect. The following Table 2.2 displays all the success factors of the BLE.

Table 2.2 Success factors of BLE

Factor	Author
Human (Faculty, learner) (pedagogical)	(Ozkan et al. , 2009); (Swedish Agency, 2008); (Schreurs ,2008); (Attwell, 2006); (Khan, 2005); (MacDonald & Thompson, 2005) ; (McNaught & Lam, 2005); (Benchmarking of Virtual Campuses , 2003);(Sustainable Environment for the Evaluation of Quality in E-learning ,2003)
Infrastructure(technological)	(Ozkan et al. , 2009); (Swedish Agency, 2008); (Schreurs ,2008); (Attwell, 2006); (Khan , 2005); (MacDonald & Thompson, 2005) ; (McNaught & Lam, 2005); (Benchmarking of Virtual Campuses , 2003);(Sustainable Environment for the Evaluation of Quality in E-learning ,2003)
Infrastructure (pedagogical)	(Ozkan et al. , 2009); (Swedish Agency, 2008); (Schreurs ,2008); (Attwell, 2006); (Khan , 2005); (MacDonald & Thompson, 2005) ; (McNaught & Lam, 2005); (Benchmarking of Virtual Campuses , 2003);(Sustainable Environment for the Evaluation of Quality in E-learning ,2003) (Hilary Page-Bucci ,2002); (Roderick, 2001)

Learning environment	(Ozkan et al. , 2009); (Swedish Agency, 2008); (Schreurs ,2008); (Attwell, 2006); (Khan , 2005); (MacDonald & Thompson, 2005) ; (McNaught & Lam, 2005); (Benchmarking of Virtual Campuses , 2003);(Sustainable Environment for the Evaluation of Quality in E-learning ,2003)
Support/educational service	(Ozkan et al. , 2009); (Swedish Agency, 2008); (Schreurs ,2008); (Attwell, 2006); (Khan , 2005); (MacDonald & Thompson, 2005) ; (McNaught & Lam, 2005); (Benchmarking of Virtual Campuses , 2003);(Sustainable Environment for the Evaluation of Quality in E-learning, 2003)
Support/Financial	(Benchmarking of Virtual Campuses, 2003); (Sustainable Environment for the Evaluation of Quality in E- learning, 2003); (Hilary Page-Bucci, 2002)
Support/ethical	(Ozkan et al. , 2009); (Swedish Agency, 2008); (Khan , 2005); (MacDonald & Thompson, 2005) ; (McNaught & Lam, 2005); (Sustainable Environment for the Evaluation of Quality in E-learning , 2003)
Cultural	(Attwell, 2006); (Khan, 2005)
Economical/political	(Ozkan et al., 2009) ; (Sustainable Environment for the Evaluation of Quality in E-learning,2003)
Legal factor	(Ozkan et al., 2009); (Attwell, 2006); (Khan, 2005)
Management and leadership	(Ozkan et al. , 2009); (Swedish Agency, 2008); (Schreurs ,2008); (Attwell, 2006); (Khan , 2005); (MacDonald & Thompson, 2005); (Zairi & Ahmed, 1999)
Service quality, content quality and system quality	(Johnson et al., 2008)
Instructors communication ability.	(Arbaugh and Duray, 2002); (Thurmond et al., 2002).
Use of new assessment strategies in online learning	(Birenbaum, 2007); (Brown et al., 1997); (Mateo & Sangra, 2007)
Improved retention , Improved outcome	(Heterick & Twigg, 2003) , (Boyle et al. , 2003); (Graham, 2002)

The success factors of BLE are written in the above Table. The human factor which consists of teacher and student is an important factor. Many studies (Ozkan et al., 2009; Swedish Agency, 2008; Schreurs, 2008; Attwell, 2006; Khan, 2005; MacDonald & Thompson, 2005; McNaught & Lam, 2005; Benchmarking of Virtual Campuses, 2003; Sustainable Environment for the Evaluation of Quality in E-learning, 2003) have mentioned it. The learning environment which is an important part of infrastructure including pedagogical, technical and technological, and organizational is second factor. The studies (Ozkan et al., 2009; Swedish Agency, 2008; Schreurs, 2008; Attwell, 2006; Khan, 2005; MacDonald & Thompson, 2005; McNaught & Lam, 2005; Benchmarking of Virtual Campuses, 2003; Sustainable Environment for the Evaluation of Quality in E-learning, 2003; Jonassen, 1999; Wilson, 1996; Duart et al., 2008; Dziuban, Hartman & Moskal, 2004; Graham, Allen & Ure, 2003) have stated the significance of it. The third factor in the Table is support which has got the parts like services related to educational activities, financial and ethical activities. Many studies from (Ozkan et al., 2009; Swedish Agency, 2008; Schreurs, 2008; Attwell, 2006; Khan, 2005; MacDonald & Thompson, 2005; McNaught & Lam, 2005; Benchmarking of Virtual Campuses, 2003; Sustainable Environment for the Evaluation of Quality in E-learning, 2003) have stated services related to educational activities. The studies (Benchmarking of Virtual Campuses, 2003; Sustainable Environment for the Evaluation of Quality in E- learning, 2003; Hilary Page-Bucci, 2002) have supported financial services. Many researchers have stated ethical support services, a success factor (Ozkan et al., 2009; Swedish Agency, 2008; Khan, 2005; MacDonald & Thompson, 2005; McNaught & Lam, 2005; Sustainable Environment for the Evaluation of Quality in E-learning, 2003).Committed leadership is being mentioned in the research work (Ozkan et al. , 2009; Swedish Agency, 2008; Schreurs ,2008; Attwell, 2006; Khan , 2005; MacDonald & Thompson, 2005; Zairi & Ahmed, 1999) The service quality, content quality and system quality are highlighted in study (Johnson et al., 2008).Instructor's communication ability is stated in the literature (Arbaugh and Duray, 2002; Thurmond et al., 2002) for success of BLE. Lastly, improved retention and improved outcome are addressed in studies (Heterick & Twigg, 2003; Boyle et al., 2003; Graham, 2002) have mentioned the use of new assessment strategies in online learning. Lastly improved retention and improved outcome are stated in some research papers (Heterick & Twigg, 2003; Boyle et al., 2003; Graham, 2002).

2.6 Total Quality Management

Quality is at the heart of education and training. It influences student's learning and eventually the kind of benefits drawn from their education (UNESCO, 2004). American-born W. Edwards Deming is considered the father of TQM. Total Quality Management (TQM) is a way of managing and improving the effectiveness, efficiency, cohesiveness, flexibility and competitiveness as a whole. The total quality management (TQM) is defined as:

"*… a management approach of an organization, centered on quality, based on the participation of all its members and aiming at long run success through customer satisfaction and benefits to all members of the organization and to society* ". (Wiklund et al., 2003, p.99)

The quality of education is defined as the ability of a student's knowledge to satisfy stated requirements. These requirements are set by the institutions, employers, accrediting bodies and professional societies (Karapetrovic & Willborn, 1997). The quality assessment and development is a crucial task for the blended learning environment. The quality development can be defined as follows:

"*Quality development covers all kind of strategy, analysis, design, realization, evaluation and continuous improvement of the quality within the given system*". (Stracke, 2006b)

A list of the principles required for the successful implementation of TQM is leadership, total commitment, total customer focus, continuous improvement, total involvement, training, education, ownership of problems, rewards and recognition, error prevention and team work. The TQM techniques like QFD, the Six Sigma, ISO 9001, the Malcolm Baldrige Quality National Awards (MBQNA), and the EFQM are some established techniques which are used to improve the quality. The MBQNA is an important framework of operations in order to encourage accountability, transparent decision making and the optimal use of available resources. The D. Kirkpatrick presented a four-level model of evaluation that can be applied to the traditional learning and also to e-learning.

At last, the main output of this research process will be the assessment framework in TQM perspective for blended learning environment in the higher education sector. The resultant assessment framework will help to assess the quality at different stages. Concerned stakeholders can use this model to assess the level of quality development initiatives and take strategic decisions to make the blended learning environment more effective and efficient. Moreover, it can also be used to sustain the continuous development work in enhancing the quality standards.

In quality management in education, teaching and learning activities are frequently divided into three groups: inputs or requirements, processes and outputs or results (Van Damme 2004; Wiklund et al., 2003; Sahney et al., 2004; Becket and Brookes, 2006).

TQM is defined as:

"a way of managing to improve the effectiveness, efficiency, cohesiveness, flexibility and competitiveness of a business as a whole." (Ho and Wearn, 1995, p. 25)

This definition of TQM explains the importance of TQM in improving efficiency, effectiveness and flexibility of business as a whole. The other principles required for the successful implementation of TQM include leadership, commitment, total customer satisfaction, continuous improvement, total involvement, training and education, ownership of problems, reward and recognition, error prevention and teamwork (Ho & Wearn, 1995). In TQM the focus is on continuous improvement.

Development and application of assessment methods are supported by regional, national, and international accrediting bodies that have aim of continuous improvement in student learning at their core .Harvey and Knight (1996) identified the following meanings to quality:

- Quality as *exceptional*, i.e., exceptionally high standards of academic achievement;
- Quality as *perfection* (or consistency), which focuses on processes and their specifications and is related to zero defects and quality culture;
- Quality as *fitness for purpose*, which judges the quality of a product or service in terms of the extent of meeting customer specifications or conformity with the institutional mission;
- Quality as *value for money*, which assesses quality in terms of return on investment or expenditure and is related to accountability; and
- Quality as *transformation*, which defines quality as a process of qualitative change with emphasis on adding value to students and empowering them.

The popular perspectives of Deming, Juran and Crosby are highlighted in Table 2.2.

Table 2.3 TQM perspective of Deming, Juran, and Crosby

Deming's 14 Points	The Juran TRILOGY	Crosby's 14 quality steps
1. Consistency of purpose 2. Adopt the philosophy 3. Do not rely on mass inspection 4. Do not award business on price 5. Constant improvement 6. Training 7. Leadership 8. Drive out fear 9. Break down barriers 10. Eliminate slogans and exhortations 11. Eliminate quotas 12. Pride of workmanship 13. Education and retraining 14. Plan of action	I. Quality Planning • Set goals • Identify customers and their needs • Develop products and processes II. Quality control • Evaluate performance • Compare to goals and adapt III. Quality improvement • Establish infrastructure • Identify projects and teams • Provide resource and training • Establish controls	1. Management commitment 2. Quality improvement teams 3. Quality measurement 4. Cost of quality evaluation 5. Quality awareness 6. Corrective action 7. Zero-defects committee 8. Supervisor training 9. Zero-defects day 10. Goal – setting 11. Error cause removal 12. Recognition 13. Quality councils 14. Do it over again

In Table 2.3, the popular perspectives by Deming, Juran and Crosby are given. In the Deming's perspectives 14 steps are included : consistency of purpose , philosophy adoption , independent of mass inspection, awarding a business on performance and not price, constant improvement , training, leadership , taking out fear from employees ,removing barriers , removing slogans, exhortations and quotas, considerations of workers pleasure , education and training programs and lastly plan of action. The Crosby's 14 points include : management commitment, formation of teams for looking after quality improvement, measurement of quality , evaluation of cost of quality , awareness to bring quality , formation of committee which looks after attaining zero defects rule, training of supervisors , conducting the event like zero defects day , setting goals , removing the cause of errors , recognizing people performance and lastly formation of quality councils .

The Juran’s triology explains three important components which are quality planning, quality control and quality improvement. Under quality planning , the activities like setting of goals , identification of customer’s needs and development of products and services are placed which is so relevant since planning is the most important to set future goals in accordance to satisfy customer’s needs . Under quality control, the performance is evaluated and goals are compared with the actual performance .In quality improvement part, infrastructure is modified to achieve goals and projects and teams are identified in an attempt to meet the targets. Training and control techniques are undoubtedly the most important features of quality improvement move of any company. Therefore, I am totally convinced with the application of Juran’s trilogy in the higher education institutions. Moreover, Crosby’s points: quality awareness and corrective actions measurement can be very advantageous in improving the quality standards of learning environment.

In the Deming’s 14 steps are included : consistency of purpose , philosophy adoption , independent of mass inspection, awarding a business on performance and not price, constant improvement , training, leadership , taking out fear from employees ,removing barriers , removing slogans, exhortations and quotas, considerations of workers pleasure , education and training programs and lastly plan of action.

Quality will be transformative if focus is given to teachers, students and internal processes of a higher education institution. The term quality management may refer to all those policies, systems and processes which ultimately contribute in the development, maintenance, improvement and control of quality within system. The word total in TQM stands for the total involvement of all employees. According to ISO 8402, quality management is that aspect of overall management function that determines and implements the quality policy for intention and direction of the organization. Quality management, in the higher education context has a wide landscape which covers the quality terminology: control, assurance and improvement.

The importance of total quality management is being addressed by different researchers in the literature review and is displayed clearly in the following Table 2.3. For example, Mann & Kehoe in 1994 has stated that TQM has beneficial impact on the performance of business. Sun (1999) has highlighted the contribution of TQM in improving customer satisfaction and business performance. A relationship between the TQM implementation and quality results has been suggested in studies (Brah et al., 2002). But Joiner (2007) has claimed for high positive correlation between TQM practices and organizational performance.

Table 2.4 Importance of TQM

Sun (1999)	Some of the TQM practices contribute to the increase of customer satisfaction and business performance
Brah et al.(2002)	Results suggest the proposition that TQM implementation correlates with quality performance.
Shenawy et al. (2007)	The used components of TQM lead to competitive advantage.
Joiner(2007)	There is a strong positive relationship between TQM practices and organization performance

No doubt, the application of total quality management has many advantages as being mentioned previously and its positive impact on business excellence is seen in many organizations yet this philosophy has got few barriers which can create problems in its application.

The barriers are : lack of top management commitment (Soltani et al., 2005;Venkatraman, 2007; Bhat & Rajshekhar, 2009) , attitude of employees towards quality (Amar & Zain, 2002; Helma & Mayo, 2008), lack of proper training and education(Jun et al. 2004; Huq, 2005; Soltani et al., 2005; Bhat & Rajshekhar, 2009), lack of coordination between departments (Salgena & Fazel , 2000; Amar & Zain , 2002; Zamany et al., 2002), human resource barrier(Jun et al., 2004; Venkatraman, 2007; Bhat & Rajshekhar, 2009) no benchmarking (Jun et al., 2004; Bhat & Rajshekhar, 2009), poor planning (Salegna & Fazel, 2000; Jun et al., 2004) , employee’s resistance to change (Soltani et al., 2005; Venkatraman, 2007) , inadequate use of empowerment and teamwork (Jun et al., 2004; Soltani et al., 2005; Venkatramen, 2007; Bhat & Rajshekhar, 2009) , lack of continuous improvement culture (Amar & Zain, 2002; Huq, 2005) , and lastly lack of communication(Salegna

& fazel , 2002; Huq, 2005). In this research also, the barriers like: lack of top management commitment, attitude of employees towards quality, lack of proper training and education, poor planning, employee's resistance to change, inadequate use of empowerment and teamwork, lack of continuous improvement culture will be of great concern during the implementation of assessment framework in the blended learning environment.

A discussion on quality development related issues and approaches are made (Stracke, 2006a). To achieve a sustainable integration of quality development within the whole organization and to ensure the involvement of all stakeholders it is so crucial to build a quality strategy so that the quality objectives can be put into the educational and business processes .The three level concept of the introduction of quality development can be very useful (Stracke, 2006b ; Stracke, 2010).The three levels are: Level of individual person; level of the organization; level with the involvement of group of external stakeholders.

The quality development needs to be a continuous ongoing process (Crosby 1980; Deming 1986). To be in the state of sustainable quality development, the whole organization must ensure the involvement of all stakeholders to build a quality strategy and to integrate the quality objectives into the educational and business processes (Stracke, 2010).Moreover, three steps of quality development: adoption, implementation and adaptation can also be introduced at each level of quality development (Stracke & Hildebrandt, 2007).

The development of a framework in TQM perspective for a blended learning environment in the

HES needs to select the best alternative out of three alternatives which means the quality development in the blended learning environment can be achieved by implementing quality development as a strategy at three levels:

- Quality development initiative (QDI) at the individual level
- Quality development initiative (QDI)at the organizational level
- Quality development initiative (QDI) at the level with the involvement of all external stakeholders

1. At the individual level, the quality development can be implemented by building the awareness to ensure that every stakeholder knows the meaning of quality development in the personal context. For example, at the learner level, the quality development awareness can be ensured at the personal level by raising motivation, improving interactions and engagement , increasing computer knowledge and explaining the appropriate use of LMS and social networking feature. In addition to this, learners can be informed regularly about the kind of improvement happening in the learning environment so that the regular feedback can be taken from them to understand their perception and expectation for further improvement. Since the blended environment stresses personalization and mastery based education, the continuous and sustainable organic development is possible in this context only when all stakeholders are capable of initiating the quality development at the personal level including learner. The optimization in the "application of learning" (which refers to the extent to which students transfer, use and apply the learned knowledge and skills to their current task, studies, and job) is directly linked in researcher's opinion by developing quality at the individual level of the learner depending upon their learning styles.

2. At the organizational level, the whole organization needs to develop a quality vision, a common understanding of the quality objectives and the resulting output in a holistic manner. For this development, the top management's leadership and commitment is very significant. Moreover, the involvement of all employees, department heads, subject leaders, instructors, administrative and support staff, technology, and technical staff is really vital in building the common understanding of the learning objectives. The top management is responsible in developing the quality of all the components of the BLE, e. g., pedagogical, technological, social, organizational, and evaluation and assessment. In addition to this, the top management is accountable for not only implementation but the communication of quality development in deciding right policies and strategies, partnership and resources, adequate funds, control processes, and deliveries to the whole organization .The contribution, motivation, and transparency from the management side will help in the achievement of mission statement in accordance with the set objectives.

3. At this level, the integration and involvement of all stakeholders of the BLE will help in bringing the quality in the business and educational process of the institution as a whole .The educational and business processes will be improved by involving parents, technology suppliers, employers, social and environment activists, government and industry representatives. This involvement can further help in the internationalization of the learning environment as per the international standards and image. Moreover, the participation of industrial, environmental, social and government representatives help in communicating the future requirements, legal and economic policies, cultural values, and international relations which can ensure the sustainable and continuous improvement in the learning environment.

   In the next subsection, the different assessment methods in TQM are discussed.

2.6.1 Assessment methods in TQM

Quality management in education has changed and taken different forms all over the world in terms of stakeholder accountability, customer satisfaction, assessment issues, accreditation, ratings, and rankings. The aim is to understand customer requirements and the focus should be only on the fact of delighting the customer.

TQM is a management philosophy and company's practices which aim to harness the human and material resources of an organization. The concept of TQM is universal and application of it has resulted in the creation of successful firms. There are various TQM assessment models which are used in different situations in order to attain excellence in the concerned environment. The assessment models are: Lean management system, SERVQUAL model, QFD model, Six sigma model, ISO 9001, D. Kirkpatrick Model, MBQNA award and lastly EFQM excellence award.

1. Lean Management System: The lean management system was initially designed by Toyota Motor. Importantly, the main focus of lean management is time and how time is used with the intention of improving responsiveness in meeting customer's demands. The original seven wastes by are overproduction, waiting, transportation, processing, inventories, movement and defects. The eighth waste is behavior.

2. SERVQUAL Model: The SERVQUAL model was developed by Parasuraman et al. in 1988 and it measures not only perceived service performance but also compares the

customer expectations for the same service. He provides a basic structure for measuring customer satisfaction for services. They have suggested to reduce the gap between customer expectation of provided performance and the actual perceived experience of that performance. The SERVQUAL model has defined service quality to have five dimensions: tangibles, reliability, responsiveness, assurance, and empathy.

3. QFD Model: The QFD (quality function deployment), a static approach to the measurement of service quality has been adopted. The basic idea of QFD is to translate the VOCs (voice of customer requirements) into the final product and/or service quality.

4. Six Sigma Model: In the Six Sigma Model, Schroeder (2008) outlines the commonly accepted Six Sigma steps as DMAIC where D: Define process; M: Measure quality variables valued by customer – set improvement goals; A: Analyze root causes of current defect levels – consider process change alternatives; I: Improve process – check and improve; and C: Control – monitor over time.

5. ISO Model: It is authorized by the International Organization for Standardization (ISO). ISO 9001 certifies a ‘process’ not a particular product or service (Schroeder, 2008). ISO provides a set of standards for quality improvements of process.

6. D. Kirkpatrick Model: The D. Kirkpatrick model is a four-level model of evaluation which can be applied to a traditional way of learning and also to e-learning .This model has got following four levels of quality evaluation of e-learning. 1. Student’s reaction, 2. Learning results, 3. Impact of learning on functioning in the workplace, 4. Impact on business results.

7. MBQNA Award: The MBQNA award ‘s criteria consist of seven essentials e.g. leadership, strategic planning, customer and market focus, measurement, analysis and knowledge management, human resource focus process management and results . The category for educational institutions in the MBQNA award was added in 1999.

8. EFQM Award: The EFQM excellence award is comprised of nine elements grouped under enabler' criteria (Leadership, Strategy, People, Partnerships and Resources and Processes, Products and Services) and four 'result' criteria (Customer Results, People Results, Society Results, and Key Results).

The next section deals with the important issue of quality in higher education.

2.7 Quality in Higher Education

The quality in higher education is explained in three broad categories of education operations: education/instructional, administration, and auxiliary. In many countries and many cultures the issue of quality management has been on the agenda of (HEIs) for quite some time. Higher education (HE) for the masses and a growing climate of increased accountability are frequently cited as rationales for a greater emphasis on quality (Becket and Brookes, 2006). Other environmental forces which reinforce the concept of quality include: the greater expectations and diversity of students as consumers, their demand for increased flexibility in provision, and increasing levels of competition within and across national borders (Brookes and Becket, 2007).

The feature of quality in higher education can stimulate national economic growth directly. The admission of international students in national universities has forced the national economies to intensify the application of TQM in the learning environment to ensure excellent quality within higher education. Furthermore, rigorous and transparent quality assurance in processes can enhance the quality of the learning environment making it more accountable and effective. The quality development and deployment feature needs to be a regular feature of the quality program for educational institutions, and hence, needs to be thoroughly explained.

Table 2.5 Definition of Quality in Business and Higher Education

Definition of Quality in Business and Higher Education				
BUSINESS		**EDUCATION**		
Definition		**Definition**		**Stakeholders**
Transcendent	Quality result from producer’s expertise	Exceptional	Quality results from expertise of professoriate	Faculty
Manufacturing based	Product confirms to specifications fitness for purpose	Fitness for Purpose (mission)	Institution is capable of meeting educational aim and objectives	External stakeholders accreditation agencies
Product based	Quality is determined by the presence or absence of an ingredient	Transformative Value – added	Linked to assessment ; evidence of quality is increased student learning	Accreditation agencies ,employers
Value-based	Acceptable performance at an acceptable price	Value for money Limited supply	External ranking , such as Macleans Resource orientation	Administrators, Parents , Student
User Based	Quality defined by consumers needs and preferences	Fitness for purpose (customer specification)	Outcomes meet specified requirements	Students and government can be identified as the customer

Quality Assurance Agency for Higher Education QAA (United Kingdom) effectively stated that the academic quality will be achieved when all the learning opportunities available to students are capable to help students achieve their goals. To achieve this academic quality, there needs to be an intense introduction of TQM models to address educational processes and manage quality in higher education (Sakthivel et al., 2005). In fact, Venkatraman (2007) has supported TQM’s success in the higher education field on the lessons drawn from industry.

In business all these words like transcendent, manufacturing based, product based, value-based, and service-based have specific meanings. The word transcendent refers to the situation which states that quality results from the producer’s expertise. The manufacturing based definition is to specify the product conformance for the purpose of fitness. The product based specifies the determination of quality on the basis of presence or absence of an ingredient. "Value based" means acceptable performance at a price. User based signifies the needs and preferences of consumers. On the other hand, in higher education the words like exceptional, fitness for purpose, transformative, value for money, user defined, and fitness for purpose (customer specification) have proper definitions. Exceptional stands for quality results from expertise of professional. Fitness for purpose is attached with the mission statement of institution and communicates about meeting educational aims and objectives of institution. The word transformative is linked to assessment, and it is evidence of a quality feature in improving student learning. The word value for money stands for external ranking. Limited supply stands for resource orientation. Fitness for purpose specifies meeting of the customer's requirements.

2.7.1 Quality in Traditional Learning

In blended learning, the face-to-face model is quite luxurious and an expensive model. It is expensive because of the less availability of high-quality research faculty. They may demand high salaries and low teaching workloads as part of their remuneration packages, and thus, raising overall teaching costs. Few studies have mentioned that learning and teaching at traditional institutions is of much higher quality than at more technologically focused institutions. This view has been reinforced by the published standards with regard to faculty and quality standards required by government assurance agencies like QAA.

2.7.2 Quality in E-Learning

In today's world, universities need to be prepared to face new challenges not only in educational, social, managerial and technological aspects but also in other areas to be fully involved in innovation and sustainability acts in global perspectives. In the coming years, higher education institutions need to ensure their survival by managing the increased demands of enhanced learning through new technology, digital skills in education, learning for the future in a global context within sustainable dimensions, and integrating technology into all aspects of their strategic planning. The holistic point of view is argued by NAHE (Swedish Agency for Higher Education) in 2008 states that:

"Existing methods of quality assessment need to be adapted. There is a need that quality aspects for e-learning are integrated into existing quality assurance systems. Internal competence and the provision of information in the e-learning area need to be guaranteed. Internal working methods need to be adapted to the special conditions which apply for the assessment of borderless education". (NAHE, 2008, p. 10)

According to Swedish Agency for Higher Education, existing methods of quality assessment needs to be adapted in e–learning so that internal competence and information can be guaranteed.

2.7.3 Assuring Quality in Education

Assuring quality has become a necessity in higher education to make it much more accountable. Quality development involves all stakeholders (learners, instructors, administrators, employers and funding agencies) in the educational process. Quality involves a multi-dimensional and multi-level concept that changes its form according to the contextual settings of the educational system.

There is not a common understanding about the actual definition of quality education. Giertz in 2000 explains the 'quality' perspective as an approach which gives considerations to standards, excellence, evaluation, and measurement. Thus, when promoting quality education, products and services of educational institutions and programs need to meet certain standards and benchmarks. The objectives are to be achieved as per given input and context variables to make sure that demands and expectations of consumers and stakeholders are met to move towards excellence.

Benchmarking has become very popular in higher education settings. Benchmarking is defined as:

"internal organizational process aiming to improve the organization's performance by learning about possible improvements of its primary and/or support processes by looking at these processes in other, better-performing organizations". (ESMU, 2008, p. 16)

Benchmarking can be used for self-assessing the institution, for a better understanding of processes, for measuring, comparing, and discovering new ideas, for obtaining data to support decision making, for identifying targets for improvement, for strengthening institutional identity, for strategy formulation and implementation, for enhancing reputation, for responding to national performance indicators and benchmarks, and for setting new standards for the sector in the context of higher education reforms.

2.8 Summary

To sum up, in today's world all the HEIs are looking for the development of an educational environment. The learning environment has got two important components: Learning and environment. The learning component can be made effective by introducing the relevant learning theories like experiential learning and social constructivism. The kolb's model for experiential learning can help different learners with different learning styles to provide quality learning experience. The different learning modes are available in higher education but the combination of e-learning and face-to-face learning is found to be more effective. The right blend of activities through the mix of traditional and virtual environment in offering mass learning, active rather than passive learning, involvement in social constructivism and cognitivism, involvement in work place like simulation, interdisciplinary and outcome based learning, personalization and emphasis on individual reasoning and reflection.

As learning is becoming more learner centered so the information techniques and tools need to be more effective and efficient to bring quality learning experience in the learning environment. However, there are enormous challenges for the education sector in bringing such an excellence and sophistication in the learning environment. The effective use of TQM tools and techniques can help in bringing more excellence in the output.

The TQM based assessment framework will be developed by collecting data from learners, faculty members, and external stakeholders. The involvement of all important stakeholders will bring positive contribution in enhancing the quality of assessment framework. In the end, the use of EFQM excellence model on causing criteria of quality in BLE can result in self-assessment of BLE by HEIs. The self-assessment is an ideal way of assessing as it helps in saving a lot of resources and time. The self-assessment excellence model EFQM can be modified as per the requirements and expectations of different HEIs.

For data collection, this research uses methods like pilot study, questionnaire study, expert opinions and interviews. In the next chapter, the adopted methodology is discussed in detail.

Chapter 3: Research methodology

3.1 Introduction to Research Methodology

The research methodology is the combination of methods or techniques used to enquire into a research project. The data needs to be collected from either theoretical or practical research. For example, management research may be strategically conceptualized along with operational planning methods and change management. However, to find out the right methodology and its right kind of application is a critical step to achieve valid and reliable results.

3.2 Philosophy of Research

The philosophy of a research is the identification of a philosophical assumption underlying other people's work and the understanding of how these assumptions might influence and assist the said research (Smith et. al, 2008). The two main ways of describing the philosophy of research are – Epistemology and Ontology.

• Epistemology: General set of assumptions about the best ways of inquiring into the nature of the world.

• Ontology: Philosophical assumptions about the nature of reality.

The philosophers have been debating for centuries to find a relationship between the data and the theory. The reasons why the understanding of the philosophy are given in a following way:

1.) It helps in the clarification of research designs.
2.) It helps the researcher to recognize which designs will work and which will not and enables the researcher to avoid going up too many blind alleys and should indicate the limitations of particular approaches (Smith, 2008)

3.) It also helps the researcher to identify and even create designs that may be outside his or her past experience. It suggests how to adapt to the research design according to the constraints of the different subjects or knowledge structure.

There are two contrasting views of conducting social science research, i.e., Positivism and Social Constructivism.

3.2.1 Positivism

Positivism says that the social world exists externally and its properties should be measured through objective methods, rather than being inferred subjectively through sensation, reflection, or intuitions. The French philosopher, Comte (1853) was the first person to encapsulate this view, he said:

"All good intellects have repeated since Bacon's time, that there can be no real knowledge but that which is based on observed facts."

According to Smith (2008), the philosophical assumptions of positivism are:

Independence: The observer must be independent of what is being observed.

Value-freedom: The choice of what to study and how to study must be decided by the objective criteria than human beliefs and interests.

Causality: The aim of the research is to find the causal explanations.

Hypothesis and Deduction: Science proceeds through a process of hypothesizing the fundamental laws and later checking its truth and falsity.

Reductionism: The problem as a whole is better understood if it is reduced in to smaller units.

Generalization: In order to generalize about regularities in human and social behavior, a sample of adequate size needs to be drawn.

Cross –sectional analysis: Such regularities can easily be identified by making comparisons of variations across samples.

3.2.2 Social Constructivism

The idea of social constructivism was developed by many authors. The social scientist does not gather facts and measure, but for them the constructions of different meanings which are the outcomes of the different people's experience play the most important role. Social constructivism says that reality is socially constructed and is given meaning by people. Reality is determined by people rather than by objective and external factors. The human interests are the main drivers of science and research progress through gathering rich data from which ideas are induced rather than by hypothesis and deductions as defined in positivism.

This research intends to assess the BLE in the higher education field using the TQM techniques. During the research we need to see the psychological, behavioral, and technological attributes of the drivers and barriers. The human dimension is the key element. The decision making techniques are based on human experiences and knowledge. The concept of quality is subjective in nature and different people have different perceptions. Hence, there will be an active involvement of social constructivism.

Positivism will be involved in the process of sampling and measuring. Thus, there is a need to have a right balance between positivism and social constructivism. In this research, both positivism and social constructivism are involved with more of a propensity towards the social constructivism. Figure 3.1 depicts it clearly.

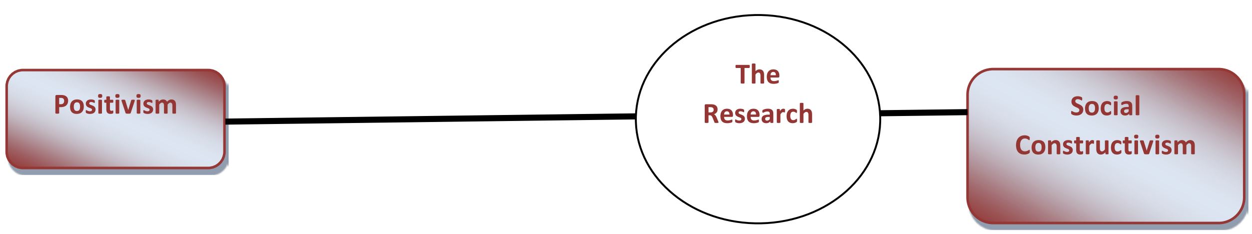


Figure 3.1: Epistemology

As mentioned earlier another branch of philosophy is ontology, which is concerned with the nature of reality. There are two main aspects to this philosophy: objectivism and subjectivism. The objectivist view is that social entities exist externally in reality. In contrast, the subjectivist view is that social phenomena are the outcome of the perceptions and consequent actions of social actors, and are, therefore, in a constant state of revision (Saunders et al., 2009). This research will have propensity towards the subjectivism as in Figure 3.2.

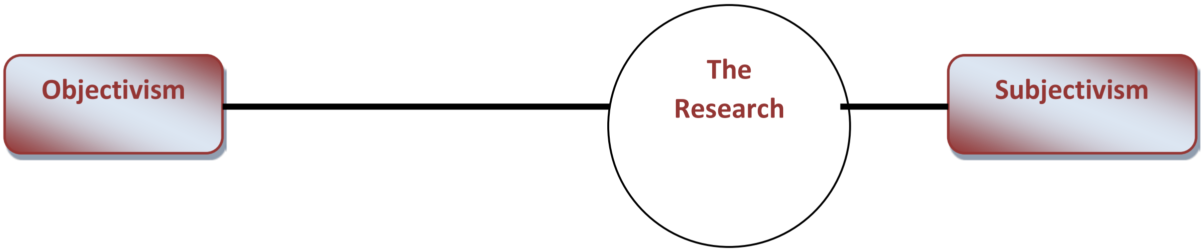


Figure 3.2: Ontology

3.3 Research Approach

The research is defined by Hughes & Sharrock (1998) as carrying out an investigation to discover something that is not already known about. The ingredients of successful research are motivation, adequate support and supervision, individual style and creativity, skills and qualities, and the right approach to start. Motivation and focus are essential to complete any research. Philips (1984) identified seven stages which were: enthusiasm, isolation, increased interest, increasing independence, boredom, frustration, and job to be finished.

The research approach normally begins with an investigation of theory that summarizes and organizes knowledge by proposing a general relation between events. The research approach consists of four components:

- Purpose of research
- Process of research
- Logic of research
- Outcome of research

The purpose of research can be exploratory, explanatory, or descriptive. According to Robson (2002), the exploratory research is conducted to find out what is happening or to find new insights into the existing knowledge. The purpose of this research is exploratory in nature as there have been limited number of studies done so far to identify the assessment framework in the BLE and this research finds new insights by developing an assessment framework using the TQM perspective.

The process of research can be either qualitative or quantitative in nature. The qualitative or quantitative research methods are explained in detail in the next section. For data collection, this research uses these methods–pilot study, questionnaire study, and interviews. Hence, qualitative and quantitative process of research will be followed.

The logic in any research uses inductive as well as deductive methods. The inductive methods are applied from specific to general situation. The deductive methods progress from general to specific situation. The deductive methods are applicable where reasoning is involved. In the beginning a deductive pattern will be followed which will involve the identification of factors during the literature review, creation of initial questionnaire, refinement of questionnaire after the pilot study, and application of decision making techniques for designing and validating the frame work. In this research, the deductive methods are involved in decision making and result in the development of the final framework.

The outcome of any research can be either applied or basic, but this research is a basic research because the aim of this research is to make a contribution in the existing knowledge of the field. The entire research approach is depicted in the following Figure 3.3.

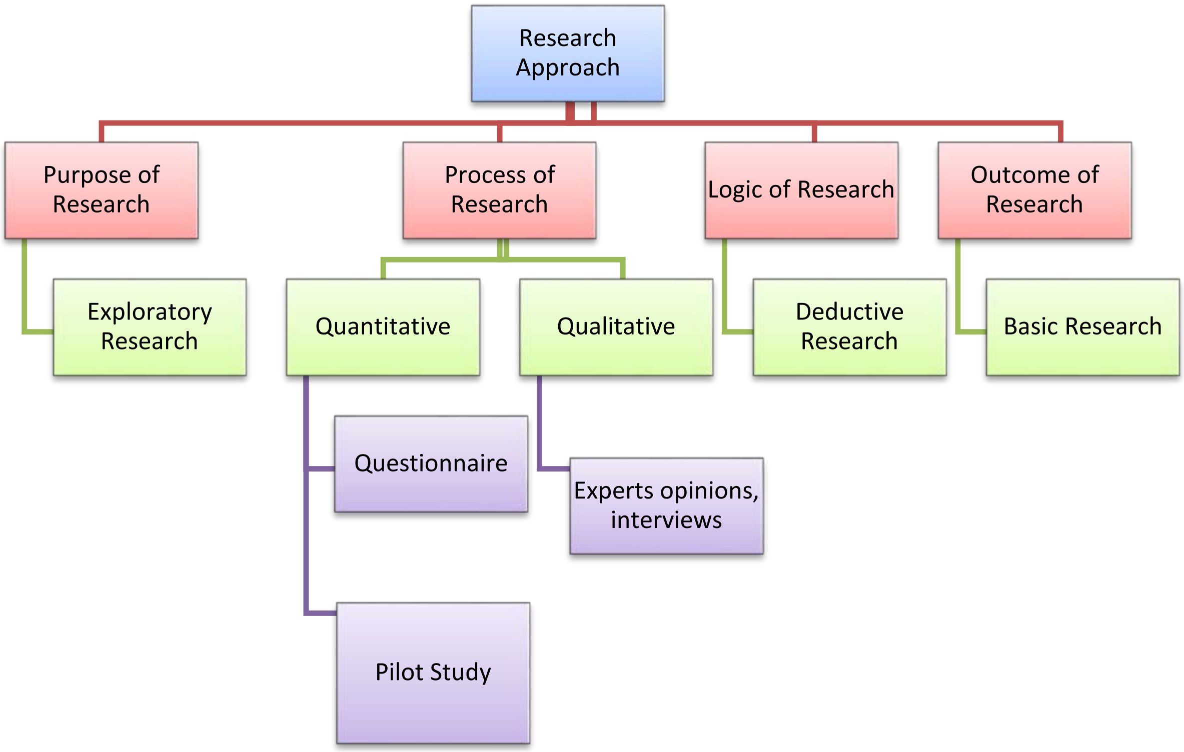


Figure 3.3: Research Approach

This research investigation is divided into two distinct aspects, firstly the design that involves the planning of the actual study, location of the study, sampling, data collection, expert opinions, collection of qualitative data, data analysis, and secondly, the process of developing the framework and the research question testing (Sekaran,1984).

3.4 Pilot Study

A pilot study is a small study which is designed to gather information prior to a larger study in order to improve the quality and efficiency of the real study. A pilot study can reveal deficiencies and gaps in the design or in the procedure. The concerning issues can then be addressed before the real study. A good research strategy requires careful planning, and a pilot study will often be a part of this strategy. A pilot study is normally small in comparison with the main study/experiment and therefore, can provide only limited information about the sources. A pilot study can also help in checking whether the instructions on questionnaire are comprehensible.

In this study, the pilot study is being conducted at IMT (Institute of Management Technology) in the academic city of Dubai. There were total 35 respondents. The institute is popular for its business courses and it is affiliated with many foreign universities. It is accredited under the ministry of higher education and scientific research of UAE and IACBE (International Assembly for Collegiate Business Education).The institute has been using the virtual learning environment, for more than two years. The students and faculty members are using the Blackboard platform extensively for uploading and downloading resources, weekly announcements, timetables, asynchronous communications, discussion boards, homework submissions, and assessments.

In the pilot study, the learners at the undergraduate and postgraduate levels are given the questionnaire instrument to check the viability and the comprehensibility of the framed questions. The discussion with few students has also given an insight into their expectations. An interview has been conducted with the administrative person who has been in charge of the quality issues. All this information has led to design the questionnaire instrument again under these categories: pedagogical, technical, organizational, social, and evaluation and assessment. Some questions are also reframed in order to give better clarity to learners

3.5 Data Collection

Sampling can be a good way of collecting data. The data can be either quantitative or qualitative. The quantitative data is represented in terms of numbers and the qualitative data is represented in words.

3.5.1 Sampling

Sampling is the process in which a sample is drawn from the population. There are two kinds of sampling designs: Probability sampling design and Non-probability design. Probability sampling designs are the one in which the probability of each entity of the sample is known. In the Non-probability sampling, the probability of any member of sample is not known. Table 3.1 explains the Probability sampling design and Non-Probability sampling design.

Table 3.1 Probability and Non-probability Sampling

Probability sampling design can be :
1.Simple Random sampling
2.Stratified random Sampling
3.Systematic random sampling
4.Cluster Sampling
5.Multistage sampling

Non -probability sampling design can be :
1.Convenience sampling
2.Quota Sampling
3.Purposive sampling
4.Snowball Sampling

Under the probability sampling design comes various sampling techniques: simple random sampling, stratified random sampling, systematic random sampling, cluster sampling, and multistage sampling. Under the non-probability design comes various sampling techniques: convenience sampling, quota sampling, purposive sampling, and snowball sampling. In simple random sampling, the individuals are chosen in such a way that each individual has an equal and independent chance of being selected. In stratified sampling, the whole population is divided into homogenous groups called strata, and the selection of sample units takes place out of these strata. For this reason, it is called stratified random sampling. In systematic sampling, the sample units are gathered under one definite system. The cluster sampling is preferable in the case of a very large population. Under this sampling technique, the population is divided into area or cluster.

In non-probability techniques, no probability techniques are involved. The convenience sampling is the kind of sampling in which sample units are selected as per the availability or convenience. The purposeful sampling is usually conducted in qualitative research studies. It allows researchers to select those items which would provide the richest possible information. Snowball sampling is used to find subjects of interest from those participants who are most likely to be able to identify.

In this research, the researcher will use convenience sampling for the purpose of convenience. This method involves selecting sample units on the basis of their accessibility. Participants who are the part of the blended learning environment and are enrolled under the blended learning programs are selected by the researcher.

3.5.2 Sample Size

An ideal sample size is the one which can provide an adequate representation of the population about which the researcher wishes to generalize. In this research, a formula is used to get the exact sample size. The rationale behind this number is because of the use of the mathematical formula of sample size. The following Equation (Eq) is representing this formula.

Sample size = (Z-score) ^{2} * StdDev^2 / (margin of error) ^{2} Eq 1

If 90% confidence interval (corresponds to a Z-score = 1.645), standard of deviation as 0.5 and margin of error of +/-5%. On substituting in the formula,

$=(1.645)^2x.5(.5))/(.05)^2$
=(2.706025x.25)/.0025
=.6765/.0025
=270.60
=270 respondents are needed

If 95% confidence interval (corresponds to a Z-score = 1.96), standard of deviation as 0.5 and margin of error of +/-5%.On substituting in the formula,

$=(1.96)^2x.5(.5))/(.05)^2$
=(3.8416x.25)/.0025
=.9604/.0025

=384.16

=385 respondents are needed

Hence, a number more than 270 and less than 385 can justify number of responses. In this research, out of 275 filled questionnaires, only 267 are valid and completely filled questionnaires.

3.5.3 Primary Data

According to Malhotra and Birks (2007), primary data means Data originated by the researcher specifically to address the research problem. Primary data is collected first hand by the researcher for the specific aims and objectives related to the undertaken research. Moreover, this accumulated information from the primary data collection process is up-to-date and more accurate information. Primary data basically involves two types of information: qualitative (non- numerical) and quantitative (numerical). Furthermore, a relationship between both types of primary data: qualitative and quantitative data can be established. The qualitative data which is collected through judgments can be converted into quantitative by assigning numbers to the judgment. For example, in case no relationship between variables can be assigned number “0”. Similarly, the judgment average relationship between variables can be assigned number “1”. Thus, qualitative information can be converted to quantitative data.

In this research, the information obtained through the questionnaire, interviews, and from decision makers (during the application of decision making techniques) is primary in nature. The data collected from the questionnaire is quantitative, but the one collected through interviews (semi-structured) and decision maker is qualitative which will be changed into quantitative data.

The beginning of this research process, the primary data (semi-structured interviews and questionnaires) is used to decide on the proposed conceptual framework. This research used both qualitative and quantitative data methods. The deductive research method is suitable for logic and decision making processes. This research has significant involvement of human dimension; hence, there is an existence of involvement of qualitative data methods also.

3.5.4 Secondary Data

According to Malhotra (1996), secondary data implies data that has already been collected for purposes other than the problem at hand. In other words, the data is already available, and it is collected by some other person or organizations or different sources such as books, journals, and company websites. Secondary data can help the researcher build the deep understanding of the undertaken research by providing different points of view and opinions about the research subject. According to Hollensen and Schmidt (2006), secondary data is "Relatively inexpensive, easily accessible, and quickly obtained".

In this study, the literature review has helped the researcher to refer to the secondary data for the development and refinement of a framework by looking to the related models for this research.

3.6 Quantitative Data Techniques

Quantitative data is the information that can be counted finitely or expressed numerically. This type of data is usually collected during experiments. It can be mathematically manipulated and statistically analyzed. Additionally, the information can be represented visually via charts and graphs. The quantitative data can be collected through several methods. However, in this research the quantitative data collection method is adopted and later quantitative data techniques are used to analyze the data. It has also helped the researcher to refine and evaluate the framework. Furthermore, a questionnaire is an important technique for collecting data.

3.6.1 Questionnaires

The questionnaire is defined by Brown (2001):

"Questionnaires are any written instruments that present respondents with a series of questions or statements to which they are to react either by writing out their answers or selecting from among existing answers."(Brown, 2001, p. 6)

A questionnaire can have different kinds of questions: Attitudinal questions, Behavioral questions, and Factual questions. The attitudinal questions are related to people's thinking. The behavioral questions are related to the respondents past experiences, and the factual questions (also called "classification" questions or "subject descriptors") are used to find out the respondent's identity. A questionnaire needs to be efficient in terms of researcher time, researcher effort, and financial resources. The importance of the questionnaire, as a method to collect data, cannot be denied, but at the same time, as Gillham (2008, p. 1) points out that in research methodology *"no single method has been so much abused"* as questionnaires.

Rensis Likert scale has multi–items scale option from 1 to 5, (e.g. "strongly disagree = 1", "strongly agree" = 5). For negatively worded items, the scores are reversed before analysis (5 becomes 1, 4 becomes 2, etc.). Few researches have used two-, three-, four-, six-, and seven-response options successfully. However, too many scale points on a Likert scale do not give reliable results. The open-ended questions are the ones which are without the response options for the respondent but followed by some blank space (e.g., dotted lines) for the respondent to fill in the required information. The personal information that is usually considered private needs to be avoided in the questionnaire. After the participant's acceptance, the researcher collected the responses from the participants from different universities.

In this research, the survey has two main parts: the first part aims to gather generic data about the learners such as gender, age, and the level of education, and the second part is based on the learner experiences with the blended learning environment and their perceived expectations of it. The second part is divided into five sections. The questions are categorized on five point Renesis Likert-type scale. Each question is anchored from 1 to 5, where 1 indicates strong disagreement and 5 indicates strong agreement. The last question is an open-ended question. The content validity of the questionnaire questions has been done under the guidance of the supervisor within the evaluation tool.

A total of 300 participants are given questionnaires but only 267 participants completed the information as per asked in questionnaire. The participants are mostly the learners in different higher education institutions in Dubai, and all of them are following higher education through the blended learning programs. The researcher has sent questionnaires to a few known students, who are studying in different universities and are enrolled in the blended learning programs. The researcher attached a covering letter to give participants a clear idea about the research problem and the reason behind this questionnaire. The aim of this questionnaire is to get responses from learners on the various factors which affect the quality of the blended learning environment in the higher education field. All three kinds of above mentioned questions are used in this research to obtain the relevant information to apply in the development of a TQM based assessment framework.

Some of the obtained information is handled through qualitative data technique. This technique is explained in the next section.

3.7 Qualitative Data Technique

In qualitative data techniques, the non-numerical data (the information which is expressed in words) is handled.

3.7.1 Interview

Interviewing is a technique that is primarily adopted to gain an understanding of the people attitudes, preferences, and behaviors. It can be conducted on one to one basis or in a group, at home, at office, in the working place, on street, at a shopping center, or some other agreed location. An interview is a kind of conversation in which the participant provides the researcher with information through verbal exchange. The researcher notes the information which becomes part of the study. Moreover, conducting the interview is inexpensive for the knowledge that can be explored in depth during this activity. One major disadvantage of interviewing is the language constraint. Sometimes the interviewer is not able to put forward the question effectively to the interviewee, and hence, a gap is formed in understanding the given information.

There are different types of interviews: structured, semi-structured and unstructured, or in-depth interviews. These can be conducted on phone, in-person, or by using other synchronous communication methods as videoconferencing. In a structured interview, the interviewer usually follows a detailed interview guide which is similar to a questionnaire in following the question order.

A semi-structured interview is useful where the researcher has a list of questions to be covered but may skip a few questions. It can differ from interview to interview which means that the researcher may leave out some questions in particular interviews depending on a specific organizational context that is encountered in relation to the research topic.

In this research, semi-structured interviews are conducted for many reasons. The researcher gets the opportunity to probe answers where the researcher wants the interviewees to explain the related issues. Furthermore, semi-structured interviews may result in the identification of the areas which the researcher had not previously considered. This kind of identification could be significant for the researcher to get a deeper understanding of the research area. Moreover, this can also help in addressing the research questions and objectives in more depth.

In this study, the interview is conducted during the pilot study and before the application of the decision making techniques in order to get the best understanding of situation in the development of framework. The issue of quality of the BLE is perceived differently by different people at different important levels, such as the faculty, administration, top management and stakeholders. The information gathered from these interviews constituted the qualitative findings of the study. The qualitative data is analyzed using content analysis. The aim of this analysis is to get the clarity of the situation .The deduced values are helpful in refining the framework and collecting significant information in support of the research findings.

The researcher arranged interviews: one from the academic head of IMT (Institute of Management Technology) during pilot study, the second from the vice chancellor of the Murdoch University in Dubai, the third interview from a faculty member of HCT (the Higher College of Technology in Dubai) , and the last one from the IT senior person in the administration of IMT. All these interviews helped in understanding the role of different factors in establishing, maintaining and enhancing the quality of BLE.

The data collected from the interviews of academic head and vice chancellor disclosed the importance of international quality criteria and accreditations of the blended learning programs. Moreover, the interview with the faculty member from HCT (The Higher College of Technology) in Dubai revealed the use of the latest technological pedagogical advancements like Flip classrooms in the university so that the students are getting maximum benefits. The interview with the IT administrative person revealed that a detailed record is kept regarding the use of the available resources by different faculty members in the blended learning programs. This is a good way to keep a track with the maturity level of use of online and other resources of one particular course structure. In the next section, the ethical issues related to collection of data are addressed.

3.8 Ethical Issues

The confidentiality issue can be handled by addressing those questions which are only related to the research subject. In this research, no personal questions are asked which can make participants feel uncomfortable. If the participants do not want to continue at any time, they have the option of withdrawing from the questionnaire and interview at any time. All the data will be protected through a password.

For the purpose of this research, all participants will remain anonymous since their identity does not affect the outcome of the research. Any hard copies will be destroyed immediately after data entry and soft copies of responses will be destroyed within 12 months of thesis publication. If participants wish to withdraw at any stage, their responses will be destroyed immediately. While the data is being entered, the hard copies are kept in a secured place for which only the researcher will have the access. The consent forms will also be kept in a locked cabinet with only the researcher having access. After the collection of data, the data will be imported to the researcher’s computer for the further analysis. Hence, it will be protected via suitable means.

3.9 Research Phases

The activities in this research have been divided into three inter-dependent phases. These phases are: research planning, research development, and research validation. The pictorial depiction of the research phases is shown in Figure 3.4. The entire set of research activities are divided into three interdependent phases: Research Planning Phase, Research Development Phase, and Research Validation Phase. A total of 15 research activities are carried out in these three phases as clearly displayed in Figure 3.4. The completion of the Research Validation Phase results in the culmination of the research work undertaken.

The research planning activities include desk studies consisting of literature review: To identify main TQM based components of BLE, to design data collection method & conducting pilot study, collection of data through pilot study and lastly the analysis of pilot study and refine the questionnaire through interviews during pilot study. The collected information is used in the development phase.

The research development activities include actual data collection through questionnaire survey, Identify the respondents and conduct Sampling (web and traditional), the exploratory factor analysis of data, application of decision making techniques, designing the framework, and enhance the framework by considering only cause criteria.

The final phase is the research validation phase, and its objective is to validate the research findings. This is done through the sensitivity analysis method. Later the EFQM method is applied to bring excellence through TQM techniques. The final findings are critically examined to draw conclusions and future research recommendations. The successful completion of the activities of this phase signifies the completion of the research process.

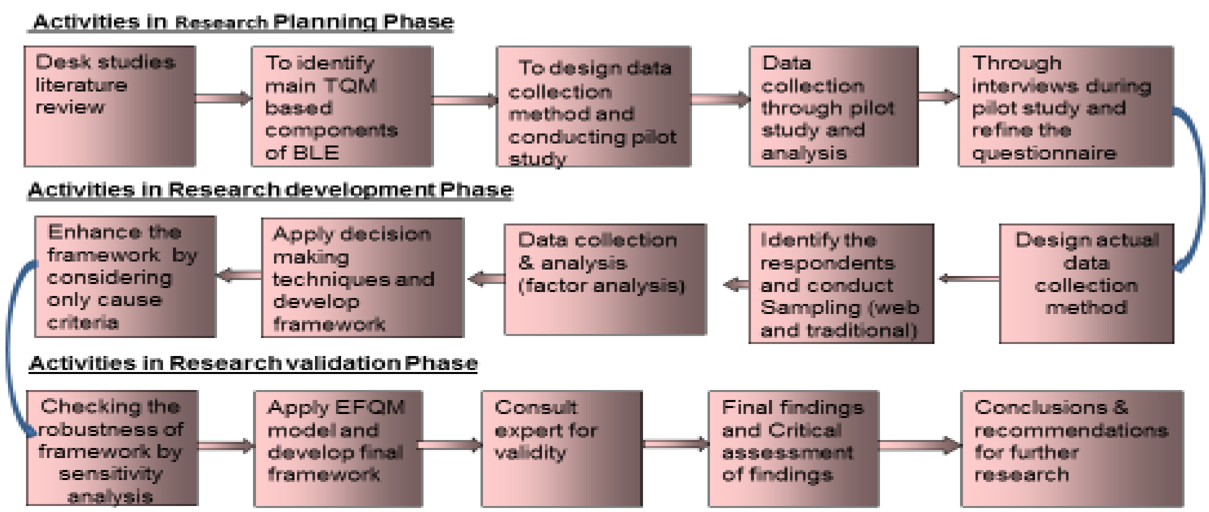


Figure 3.4: Research Phases and Activities

3.10 List of Adopted Quantitative Analytical Techniques

The list of adopted analytical methods for this research is displayed in the following Table 3.2. This Table 3.2 explains the adopted analytical approach in the first column and the corresponding results in the second column.

Table 3.2 Adopted Analytical Methods

Adopted Methods

Analytical Approach	Results
Factor Analysis (conducted on learners responses)	Deduced factors and components
DEMATEL (conducted on faculty responses)	Cause and Effect group
SDV method	Weights are calculated
Entropy method	Weights are calculated
MOORA method (Conducted on employer and experts responses)	Prioritization of alternatives through ranking
Sensitivity Analysis	Use for validation
EFQM method	Achieving excellence by focussing on concepts of TQM

6

The Table is explained in steps in the following way:

Step 1:

Firstly, Exploratory Factor Analysis is done to derive or extract the main factors and underlying criteria of factors.

Step 2:

On the results of the Factor analysis, The Decision Making Trial and Evaluation Laboratory (DEMATEL) technique will be applied. DEMATEL technique will be used to analyze the intertwined effects of the criteria. The DEMATEL can confirm interdependence among criteria and divides them into cause group and effect group. An IRM (impact-relation map) can be constructed to highlight the relationship between factors as well as criteria.

Step 3:

After DEMATEL, the application of the MOORA (Multi Objective Optimization on the basis of Ratio Analysis) method will help in optimization of multi criteria with respect to three alternatives. A decision matrix will be constructed which will represent the performance measures of alternatives with respect to various criteria. The alternatives are:

1. Alternative 1: at the individual level

2. Alternative 2: at the organizational level

3. Alternative 3: at the external stakeholder's level

Performance ratings (in terms of linguistic variables) for all alternatives under subjective criteria will be dependent upon expert's perceptions and experience. This method will result in the ranking of alternatives as rank1, rank2 and rank3.This method will be applied twice. First time, it will be applied on all the criteria and second time, it will be applied only on cause criteria (results of DEMATEL technique).

Step 4:

The Sensitivity analysis will be used for the validation of results of the MOORA technique which indicates the robustness of ranking in assessing the quality of BLE in HEIs.

Step 5:

The results of the DEMATEL and the MOORA method will be combined and all cause criteria (results of the DEMATEL technique) will be divided under three ranks (results of the MOORA method) as per the expert's opinion and EFQM model will be applied on it for self-assessing the present status of quality of BLE in any HEI and enhancing the future quality prospects.

The flowchart is also shown in figure3.5 which gives the right picture of flow of different analytical methods to bring more clarity .On learners responses, the Exploratory Factor Analysis is done to derive or extract the main factors and underlying criteria of factors. On the results of the Factor analysis, The Decision Making Trial and Evaluation Laboratory (DEMATEL) technique will be applied. DEMATEL technique will be used to analyze the intertwined effects of the criteria. The DEMATEL can confirm interdependence among criteria. The cause criteria are taken for further analysis. Next, the application of MOORA method will result in the ranking of alternatives as rank1, rank2 and rank3.This method will be applied twice. First time, it will be applied on all the 33 criteria (results of Exploratory Factor Analysis) and second time, it will be applied only on cause criteria (results of DEMATEL technique).The two methods (Entropy method and SDV method) are used separately for assigning weights. Both the methods give same ranking to the alternatives verify the ranking. The Sensitivity analysis will be used for the validation of results. Next, and all cause criteria (results of the DEMATEL technique) will be divided under three ranks (results of the MOORA method) as per the expert's opinion and EFQM model will be applied on it for self-assessment. In the next few subsections, all adopted methods are explained in a detailed way.

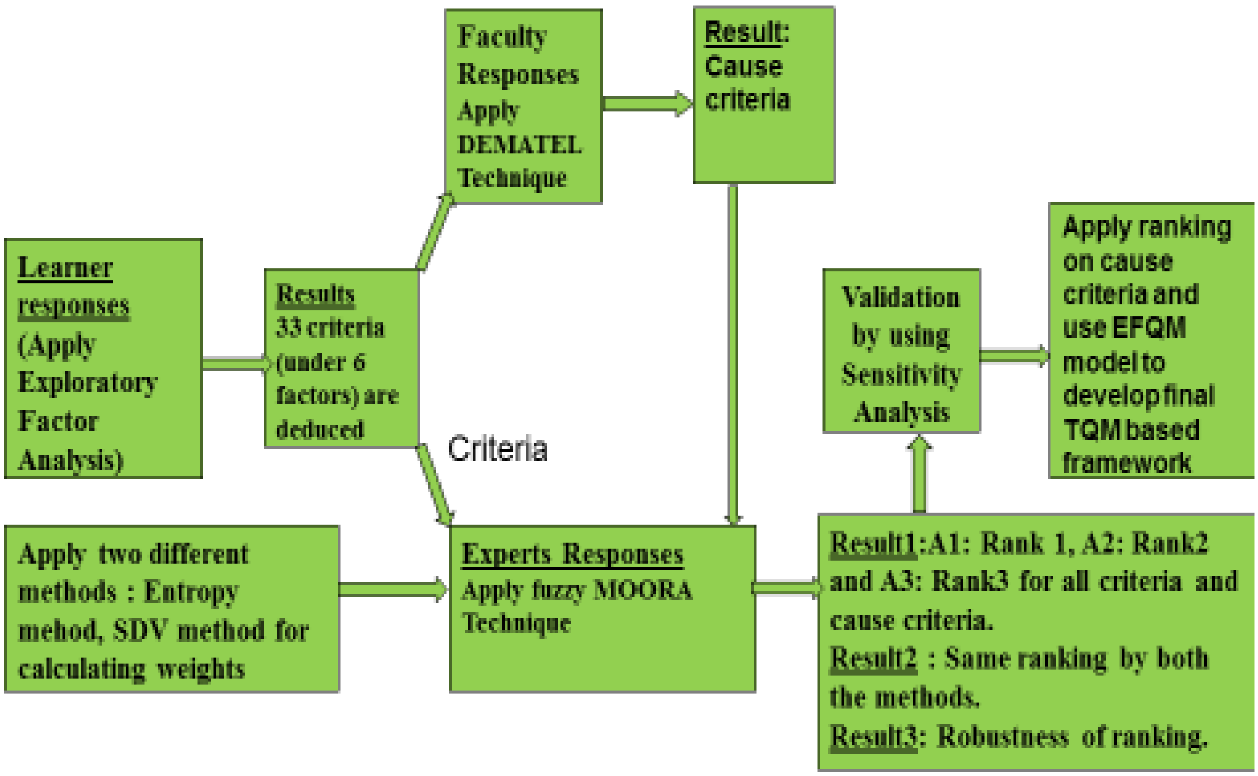


Figure 3.5: Flowchart of applied techniques

3.10.1 Exploratory Factor Analysis

After gathering data from the survey, the data analysis was carried out by using SPSS analysis. SPSS is a computer software program used to do exploratory factor analysis; the purpose of which is to determine the minimum number of latent factors that can account adequately for or reproduce the correlation matrix. Before running the analysis, the researcher had to select some options to control the factor analysis and add some useful extra items to the output. First, in the descriptive options, the researcher choses the descriptive statistic which shows means and standard deviations for each factor; Initial solution, to display the original communalities, eigenvalues and the percentage of variance explained; coefficients, to tabulate the R-matrix; and Reproduced, to obtain an approximation of the R-matrix from the loadings of the factors extracted by the analysis.

The Reproduced option would also obtain communalities and residual differences between the observed and reproduced correlations. The Second option was Extraction. The researcher chose Scree plot which is a useful display showing the relative importance of the factors extracted. Finally, to obtain the rotated F-matrix in the Rotation options the researcher selected the Varimax method.

The data can be examined using statistical and qualitative analysis. Under the statistical analysis, Descriptive statistics were run to find out central tendency and variability of the collected data. The Excel sheet of results is provided in the Appendix. The researcher measured the latent variables with the help of factor analysis which are otherwise difficult to be measured directly. These factors are then named according to their characteristics. The factor analysis is the technique to find out the groups or clusters of variables. This technique has three main uses (Field, 2009).

1. To understand the structure of set of variables.

2. To construct a questionnaire to measure an underlying variable.

3. To reduce the data set to the more manageable size while retaining as much of the original information as possible.

In this research, the researcher’s aim was to measure the impact of those components which are responsible for assessing the quality of the blended learning environment in the higher education field. The Crobanch‘s coefficient of reliability, alpha will be used to find out the internal consistency of those components.

3.10.1.1 Identifying Factor Structure

Before the factor analysis, the relationship between all these variables can be arranged in R- matrix form. An R-matrix is a correlation matrix which is made up of correlation coefficients between the variables. The diagonal element of such matrix will always be one as each variable will perfectly correlate with itself. The analysis might result into clusters of some variables which are having large correlation coefficients or small correlation coefficients. These subsets of variables will measure one particular dimension which is known as a factor. Few factors may be very significant and few may not be very significant for the assessment of the BLE (in TQM perspective) in the higher education field.

The values of correlation coefficients which are greater than 0.9 can create a multicollinearity problem. If the variables correlate too highly, it means the multicollinearity exists. For a non-singular matrix, the determinant of the R-matrix is not zero which indicates that absence of multicollinearity.The determinant value of R matrix needs to be more than 0.00001 to avoid multicollinearity problem. In R-matrix, there will be variability content in the variables. The total variance in the variable will have two components. The one component can be of the nature which will be shared by other variables, and hence, it is called a common variance and the other component can be of the nature which is specific to that variable. Thus, it will be called as the unique variance.

However, there can be a unique variance which will not be reliable and as a result can be called an error or random variance. The communality means the proportion of common variance present in a variable. The communality will take value 1 if there is no unique variance but at the same time the communality will take value 0 if the common variance is not present. The principle component analysis results unlikely in many solutions if the number of variables is more than 30 and the communalities values are more than 0.7 Stevens (2002).

3.10.1.2 Factor Extraction: Eigen values, Scree plot and KMO (Kaiser –Meyer-Olkin) Measure of Sampling Adequacy

A scree plot is a plot in the shape of debris. In this graph the values on the x axis represent factor values and the values on the y axis represent Eigen values. The factors with high eigenvalues are retained in the analysis. It gives a rough idea of number of extracted factors. According to him, all factors whose Eigen values are more than 0.7 will be extracted. After the factors extraction, to what degree, the variables load onto factors will be given by factor loadings. If the factors are related to each other than oblique rotation method is used and if they are not related then orthogonal rotation method will be used.

KMO value more than 0.5 is barely acceptable. The values between 0.7 and 0.8 are good and the values between 0.8 and 0.9 are great. The values which are more than 0.9 are superb. If the correlations exist between the variables, then according to Barlett's test, it needs to be different than the identity matrix. Identity matrix will signify that there is no correlation between the variables. The matrix other than the identity matrix signifies the relationship between the variables. The factor rotation effectively rotates the factor axes so that variables are loaded maximally to only one factor. The factor loadings are a gauge of the substantive importance of a given variable to a given factor. The two types of rotation are orthogonal rotation and oblique rotation. The orthogonal rotation ensures that the factors remain uncorrelated. The oblique rotation ensures that factors are allowed to correlate. The factor transformation matrix is needed to rotate each matrix with different amounts.

The factor extraction from the help of exploratory analysis using SPSS has resulted into following important Tables.

1-Descriptive Statistics Table: The first output obtained from the analysis is a table of descriptive statistics for all variables under investigation. This table shows the values of mean, standard deviation, and number of respondents who participated in this survey.

2-The correlation matrix (*R*-Matrix) Table: The second output obtained from the SPSS analysis is the correlation matrix (R-Matrix). A correlation matrix is simply a rectangular array of numbers which gives the idea about the correlation coefficients of paired variables of all involved variables in the survey. The diagonal elements of this correlation coefficient are always 1 which shows that all variables relate with themselves perfectly. The off–diagonal elements can take any value between -1 to 1 depending upon the relationship between any two paired variables. The positive values indicate that there is positive correlation between the variables and negative values indicate that there is negative correlation between the variables.

In fact, this matrix helps the researcher to check the pattern of relationships. This R matrix can be reduced down to its underlying factors by scanning the significance values and clustering them in a meaningful way. This step helps in the reduction of original data into meaningful factors. The problem of singularity can exist if the correlation coefficients take any value greater than 0.9. At this stage the researcher can solve this problem by eliminating one of the two variables causing the problem.

3-Communaliities: Output 3 is a table of communalities and helps in calculating the variability in scores. The Table of communalities shows the amount of the common variance that was accounted for in the variables by the extracted factors.

4-Total Variance Explained: The next table represents all factors (components) extractable from the analysis along with their eigenvalues, the percent of variance attributable to each factor, and the cumulative variance of the factors. The columns are labelled as initial eigenvalues, extraction sums of square loadings and rotation sums of squared loadings contain the eigenvalues and the contributions they make to the total variance. The eigenvalues help in determining the number of factors which will remain in the analysis following Kaiser's criterion. The factor whose eigenvalue is less than 1 is excluded from the analysis. The second column, extraction sums of square loadings, repeats the results of the first column only for the six factors that meet Kaiser's criterion. The third column, rotation sums of squared loadings, represents the output for the rotated factor solution.

5-Scree Plot: The scree plot is a chart which contains eigenvalues and the number of extracted factors. The eigenvalues are plotted on the y axis and the extracted factors are plotted on the x axis. The graph is really important for determining how many factors to retain in the analysis. The point where the curve begins to flatten out shows that factors after this point are not of much value and are excluded from further investigation.

6-Component (factor) Matrix: This shows the loadings of the thirty-three variables on the extracted six factors .These are the correlations between the variables and the unrotated factor components. The higher the absolute value of the loading, the more the variable contributes to the factor. Loadings less than 0.5 are not significant.

The result of Exploratory Factor Analysis will give the true picture of important factors and underlying criteria in terms of the learner's responses. The result will be shown to the faculty members for their expert opinion so that DEMATEL technique can be applied on these deduced factors and underlying criteria. The logic of adopting this technique is given in the next section.

3.10.2 Why DEMATEL

The logic behind adopting this technique is to divide the whole set of factors and underlying criteria into cause group and effect group. The cause group (either consists of cause criteria or cause factors) dispatches the most influence on the effect group (either consists of effect criteria or effect factors) criteria. This technique is applied two times in a row, one on a set of factors and the other on the set of underlying criteria. The practical implication of this technique will be; that in future the quality development initiative can be applied intensely only on the cause group criteria (the results of this DEMATEL technique). The application of quality development initiative only on the limited number of causing criteria will definitely result in reduction of time, efforts, resources, and cost parameters. This will eventually help higher education institutions to achieve quality excellence in the BLE.

3.10.2.1 DEMATEL Method

The DEMATEL (The Decision Making Trial and Evaluation Laboratory) method was developed between 1972 to 1979 by the Science and Human Affairs Program of the Battelle Memorial Institute of Geneva. This method is one of the Multi Criteria Decision Making (MCDM) methods. The MCDM methods are being used in this research to offer a solution by combining the qualitative subject matter expert opinion with quantitative mathematical techniques. MCDM techniques become very useful for discriminating among alternatives. There are some limitations of MCDM. For example, it remains really difficult to model inputs such as political influence or public opinion, but despite all these constraints, it is being concluded by some researchers that the combination of MCDM models provide even more realistic solutions(Karsak et al., 2002; Lee and Kim, 2000). The technique of DEMATEL is chosen to do further analysis. This analysis results in the identification of cause group (factors and criteria/variables) and effect group (factors and criteria/variables). This technique is explained in a detailed way in the next subsection.

The primary purpose of this was to investigate the relationship between complex and intertwined group of variables. It has been extensively accepted as an important tool to solve the cause and effect relationship among the evaluation criteria (Tzeng et al., 2007, Wu and Lee, 2007). This method is applied extensively to analyze and construct the relationship of cause and effect among evaluation criteria (Yang et al., 2008) or to derive interrelationship among factors.

In this research, this method is applied not only on factors but the underlying criteria for each factor also. This method is also used across quality features of a complex system to analyze the strength of influence and reason of direct/ indirect causation. Thus, the core issues related with the quality related activities can be identified easily and can be controlled. This method also provides a visual representation of the causal relationship of the numerous available components. This kind of graphical representation is also named as digraph. The application of this method has been seen in various fields, particularly management problems (Tamura & Akazawa, 2005; Huang et al., 2007; Liou et al., 2008; Tzeng et al., 2007; Wu & Lee, 2007),control systems (Hori & Shimizu, 1999), reliability engineering (Hosseini et al., 2006) and others. Recently Lee and Hsieh (2011) used DEMATEL to find out the causal relationship of the service attributes. The procedure of DEMATEL method is presented in the next subsection.

3.10.2.1.1 Procedure of Applying DEMATEL

The procedure of DEMATEL technique is explained in the following steps:

Step 1:

The scale is defined for the decision matrix ranging integer value from 0 to 4. A higher value is assigned if the respondent feels a strong direct influence between the indicators. The score 0 signifies “no response”, 1 signifies “little influence”, 2 signifies “moderate influence”, 3 signifies “high influence”, and the score 4 signifies “very high influence”.

Step 2:

The initial direct influence matrix, D_{nxn} is formulated as Equation 2, where d_{ij} represents the influence of element i on element j, (i, j belongs to values from 1 to n). The elements of this initial matrix are the values of the responses which are taken directly from the respondents. These responses are dependent upon the respondent’s judgment. Later the average direct influence matrix Z_{nxn} is formed as in Equation 3 in which each element of the matrix will be derived by taking the average values of the scores d_{ij} assigned by the different respondents for the same indicators.

$$D_{nxn} = \begin{pmatrix} d_{11} & .. & d_{1j} & .. & d_{1n} \\ .. & .. & .. & .. & .. \\ d_{i1} & .. & d_{ij} & .. & d_{in} \\ .. & .. & .. & .. & .. \\ d_{n1} & .. & d_{nj} & .. & d_{nn} \end{pmatrix} \qquad \text{Eq 2}$$

The average influence matrix is given by following way:

$$Z_{nxn} = \begin{pmatrix} z_{11} & .. & z_{1j} & .. & z_{1n} \\ .. & .. & .. & .. & .. \\ z_{i1} & .. & z_{ij} & .. & z_{in} \\ .. & .. & .. & .. & .. \\ z_{n1} & .. & z_{nj} & .. & z_{nn} \end{pmatrix} \qquad \text{Eq 3}$$

Step 3:

The sum of all the rows and all the columns are calculated by Eq 4.The maximum value out of maximum of row sum and column sum is calculated and later all the elements of matrix *Z* is divided by this maximum value. The normalized direct influence matrix, *X* will be calculated.

$$X = \frac{z}{max(max(1 \le i \le m) \sum_{j=1}^{n} zij \;, \quad max\;(1 \le j \le n) \sum_{i=1}^{m} zij)} \qquad \text{Eq 4}$$

Step 4:

The matrix of total relations, *T* which is (full direct/ indirect influence) can be derived from the Eq 5.

$$T = X^* (I - X)^{(-1)} \qquad \text{Eq 5}$$

Where *I* is the identity matrix and $(I - X)^{(-1)}$ is the inverse of the matrix *(I – X)* matrix. To obtain a map of relationship, a digraph, a decision-maker must set a threshold value to filter out some negligible effects. In fact, while doing this only the values more than the threshold value would be retained and shown in digraph. The threshold value can be calculated as the average of all the values of matrix T or is decided by the decision-maker or by experts through discussion.

Step 5:

The Total-relation matrix ($T = t_{ij}$) will be analyzed in a detailed way .The sum of rows and sum of columns are calculated .Suppose D_i represents the sum of all the elements of row *i* of matrix *T*. It shows the total amount of influence (directly or indirectly) dispatched by the component *i* on other components. Suppose Rj represents the sum of all the elements of column j of matrix *T*. This shows the total influence received by the component j from the other components. The sum of columns *(D)* and the sum of the rows (R) are calculated by using Eq 6 and Eq7 respectively.

$D_i = \sum_{j=1}^{j=n} \boldsymbol{t_{ij}}$ for all i = 1, 2….n Eq 6

$R_j = \sum_{i=1}^{i=n} \boldsymbol{t_{ij}}$ for all j = 1, 2….n Eq 7

The value of *(D + R)* is important and indicates the amount of influence of both dispatch and receipt. The more related factors will have high values of *(D + R).* In the same way, the value of *(D – R)* shows the "severity of influence".

In fact, the prioritization of factors can be decided with the help of *(D – R)* values. In general, higher value of *(D – R)* indicates that it is a "cause factor", which dispatches the influence to other factors and the lower value of *(D – R)* indicates that it is an "effect factor", which receives the influence from the other factors. If the factors show the higher values of *(D – R)*, then it means that they will dispatch more influence on others. With this more influence, they are presumed to have more priority over the others.

Hence, in other words, it can be stated that the lower values of *(D – R)* of factors indicate the more influence on these factors by the other factors or lower priorities of these factors as compared to others. All values of (*D* + *R*) and (*D – R)* are arranged in the descending order. Practically, the value of (*D – R) i*s more effective and applicable than (*D*+ *R).* The component with the highest positive value of (*D – R)* can be named as the master dispatcher, and the component with the lowest value of (*D – R*) can be named as the master receiver.

All stakeholders in a BLE desire to get optimum benefits from the learning environment in shortest period of time and at an economical cost to improve the quality of lifelong learning.

3.10.3 Why MOORA

The researcher will apply the next analysis which is named as the MOORA analysis. This analysis will help in ranking the alternatives in an effort to optimize the quality of the BLE by optimizing all the criteria (cause and effect) which form an optimal BLE. All stakeholders in a BLE desire to get optimum benefits from the learning environment at shortest period of time and at an economical cost to improve the quality of learning for long life. This technique can be very beneficial in achieving this objective. This analysis is explained in detailed manner in the next subsection.

3.10.3.1 MOORA Method

Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) or is also called as Multi-criteria or Multi Attribute Optimization. The MOORA method was introduced by Brauers (2004) in a manufacturing environment to solve a multi-objective optimization problem. MOORA method starts with a decision matrix (Brauers et al., 2006) in which the performance of various attributes (criteria) with respect to alternatives is displayed on the basis of ratio analysis. This method is applied to rank the alternatives related to quality development at three levels. In this method multi criteria (objectives) sometimes conflicting are simultaneously optimized to attain the optimality of main objective function. The following steps are taken:

Step 1:

The first step is to find out the objective function and the related attributes or criteria in the evaluation attributes. For example, in this research an attempt is made to optimize the quality of the BLE with respect to all the criteria under consideration for evaluation.

Step 2:

The next step is to represent all the information available for the attributes or criteria or objectives in the form of a decision matrix. The decision matrix usually has four main components: alternatives, criteria, objectives or attributes, weights (relative importance) of each criteria, and performance measure. The elements of the matrix, X_{mxn} are the values x_{ij} (the performance measure of i th alternative on j th attribute/criteria /objective) where m is the number of alternatives, and n is the number of attributes. A ratio system is developed which helps in the computation of each performance of an alternative.

Develop the initial decision matrix, X_{mxn} :

$$X_{mxn} = \begin{pmatrix} x_{11} & .. & x_{1j} & .. & x_{1n} \\ .. & .. & .. & .. & .. \\ x_{i1} & .. & x_{ij} & .. & x_{in} \\ .. & .. & .. & .. & .. \\ x_{mi} & .. & x_{mj} & .. & x_{mn} \end{pmatrix} \quad \text{Eq 8}$$

Where the elements of this matrix represent the performance value of the i th alternative on the j th criterion, m is the total number of alternatives and n is the total number of criteria. The decision table shows alternatives as Ai (for all $i = 1, 2, . . . , m$) , attributes as C_j (for all $j = 1, 2, . . . , n$), weights of attributes, w_j (for all $j = 1, 2, . . . , n$) and the measures of performance of alternatives are represented as x_{ij} (for $i = 1, 2, . . . , m$; $j = 1, 2, . . . , n$). The end task of the decision maker is to find the best alternative and/or to rank the entire set of alternatives. All the attributes or criteria C_j for the BLE are divided into the category of beneficial (i.e. higher values are desired) and non-beneficial (i.e. lower values are desired).

Step 3:

All the individual values of x_{ij} are divided by the square root of the sum of squares of each alternative per criteria. The ratio can be written mathematically in the following way.

$$x_{ij}^{*} = x_{ij} / \sum_{i=1}^{m} \sqrt{[x_{ij}]^2} \text{ for } j = (1, 2\ldots\ldots n) \quad \text{Eq 9}$$

x_{ij}^{*} , a kind of dimensionless number which takes the value in the interval [0 1] and it is a measure of normalized performance of the i^{th} alternative and the j^{th} criteria.

Step 4:

In this step all the normalized performances are taken in to account. A few normalized values are added in case of maximization (for beneficial criteria/attributes) and subtracted in case of minimization (for non-beneficial criteria/attributes). Then the optimization problem becomes the following:

$$y_i = \sum_{j=1}^{g} x_{ij}^{*} - \sum_{j=g+1}^{n} x_{ij}^{*} \quad \text{Eq 10}$$

Where g is the number of criteria/ attributes to be maximized, (n-g) is the number of criteria/attributes to be minimized, and y_i is the normalized resultant value as being given in Eq (10) of the i^{th} alternative with respect to all criteria ($j= 1,2\ldots n$). The resultant can be positive or negative depending upon whether the total benefit value is more than the total cost value or the total cost value is more than the total benefit value.

In some cases, when some criteria have more importance than the others, then weights are attached to these criteria. The higher values of weights give more importance to one criterion as compared to the other. The criteria values are multiplied with its corresponding weight (w) (significance coefficient) to give more importance to criteria .When these weights are attached with criteria values, then Eq10 turns into Eq11. The Eq 11 is written as follows:

$$y_i = \sum_{j=1}^{g} w_i x_{ij}^{*} - \sum_{j=g+1}^{n} w_i x_{ij}^{*} \text{ for } [\, j = 1, 2, 3 \ldots n \,] \qquad \text{Eq 11}$$

Where y_i value shows the resultant.

Step 5:

The alternatives will be ranked on the basis of final y_i value. Hence, the best alternative has the highest y_i value and the poor alternative has the lowest y_i value.

The values of x_{ij} are collected in this research from three experienced experts in the field of quality. Two of them are from academia and are involved in the research area of quality. One expert is job consultant and has a wide variety of experience in the application of TQM models like EFQM .He is also a jury member for the excellence awards for quality in Dubai.

In order to get the initial decision matrix and weights, the experts gave their opinion using a fuzzy conversion 11 point scale (see Table 3.3) which was based on set theory and originally proposed by Chen and Hwang in 1992 .For each criterion, the experts are asked for their opinions. They are asked to fill the information (with what intensity, the quality initiative needs to be implemented for all alternatives) for all criteria. The above mentioned 11 point scale converts the linguistic values of the qualitative attribute or criteria into the corresponding fuzzy numbers. The numerical crisp values are assigned for each qualitative attribute/criterion as per the Table 3.2 below. The assignment of crisp values to a qualitative criterion will convert it into the criterion with quantitative attributes. The presentation of this scale is shown in Figure 3.6. Rao and Parnichkun (2009) have also used this scale.

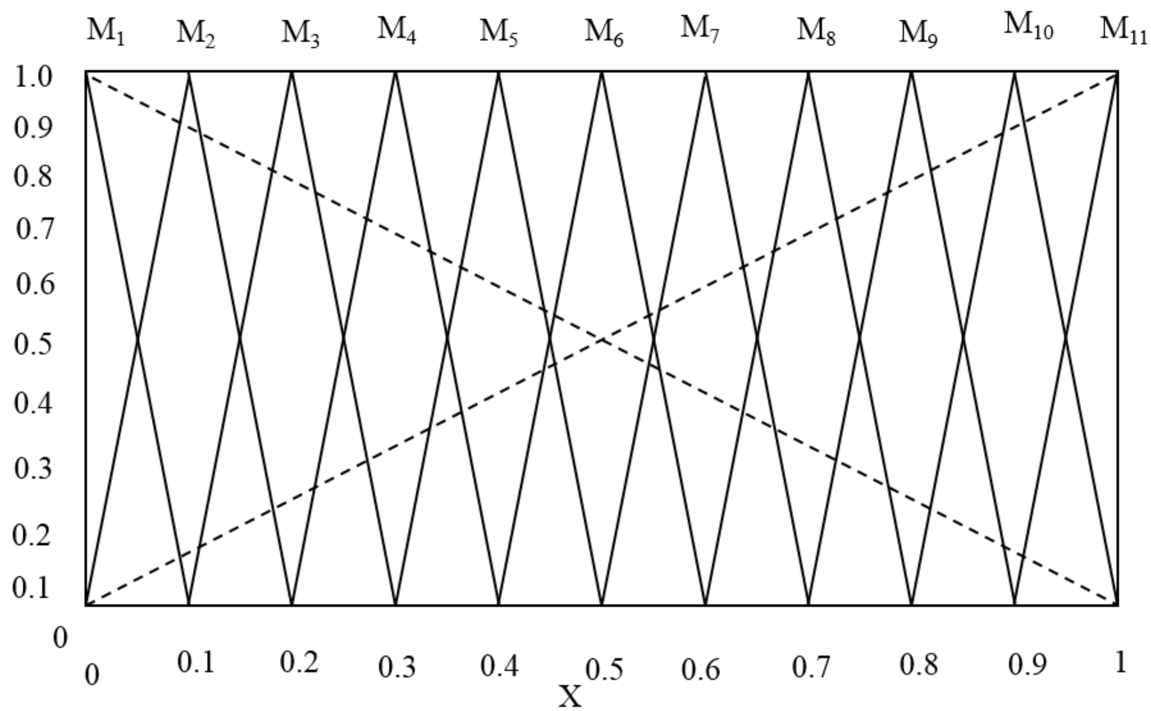


Figure 3.6: Representation of Fuzzy Conversion 11 Point Scale (Chen & Hwang, 1992)

Table 3.3 Assignment of Fuzzy Conversion 11 Point Scale

Qualitative measure of selection criteria / attribute	Fuzzy number	Assign Crisp values
Exceptionally low(EL)	M1	0.04556
Extremely low(ExtL)	M2	0.13647
Very low(VL)	M3	0.22738
Low(L)	M4	0.31825
Below average (BAV)	M5	0.40916
Average(Av)	M6	0.50000
Above average(AAG)	M7	0.59095
High(H)	M8	0.68186
Very high(VH)	M9	0.77278
Extremely high(EXTH)	M10	0.863654
Exceptionally high(EH)	M11	0.95456

As no preference is mentioned by experts, that is why, I have decided to use SDV-(Standard Deviation) method and Entropy method for assigning weights through the use of information provided by three experts. In SDV method, the concept of standard deviation will be applied to allocate the weights of different criteria. The weights of criteria give an idea about the importance of them. The standard deviation method is explained in a detailed way.

3.10.3.1 Standard deviation Method

In MCDM techniques, the decision of allocating weights is a crucial task depending upon the importance of the criteria. There are numerical methods available to allocate weights in such cases. This method starts with range standardization as in Eq 12 of the average initial matrix which is obtained from the MOORA method. This step transforms the different scales and units (as used in measuring various criteria) into common measurable units. Thus, weights can be compared (being in the same measurable units).The steps involved are:

Step 1:

Find the value of

$$x_{ij}^{*} = \frac{x_{ij} - \min\limits_{1 \le j \le n} x_{ij}}{\max\limits_{1 \le j \le n} x_{ij} - \min\limits_{1 \le j \le n} x_{ij}} \qquad \text{Eq 12}$$

Where x_{ij} are the values of the initial average matrix,which was derived by taking the average values of the opinions of three decision makers.The maximum value of the criterion (j), $1 \le j \le n$ is represented as max x_{ij} and minimum value of the criterion is represented as min x_{ij}. The matrix after the range standardization is named as $D' = (x_{ij}*)$. All the values $(x_{ij}*)$ of this matrix will be lying in the range of $0 \le x_{ij}^{*} \le 1$.

Step 2:

The standard deviation (*SDVj*) for all criteria is calculated independently using Excel with the help of formula as mentioned in Eq13

$$SDV_j = \sqrt{\frac{\sum_{i=1}^{i=m} (x_{ij}^{*} - \overline{x_j^{*}})\text{^}2}{m}} \qquad \text{Eq 43}$$

Step 3:

The weight (w_j) for each criterion will be calculated using the following formula:

$$w_j = SDV_j / \sum_{j=1}^{j=n} SDV_j \qquad \text{Eq 14}$$

Where the value of $j = 1,2 ,3\ldots\ldots n$

In the next step, the weights of all criteria are multiplied by the corresponding values in the normalized matrix. MOORA is applied again to rank the alternatives as represented in MOORA method in Eq11.

Step 4:

All the values of w_i are multiplied by x_{ij}^{*} (values of normalized matrix) for all three alternatives The criteria are divided into two groups: benefit group and cost group. The total value of $w_i * x_{ij}^{*}$ (value of weight multiplied with value of normalized matrix for all three alternatives) of benefit group will give values for total benefit. Similarly, the total value of $w_i * x_{ij}^{*}$ for all the alternatives are added for cost group. The composite score is obtained by subtracting the final score of cost group criteria from the final score of benefit group criteria for all three alternatives. The final ranking of alternatives depends upon the composite score. The alternative with the highest composite score is ranked first. The alternative with the lowest composite score is ranked last.

In the next phase of research, the other method is used which is called the Entropy method to find out the weights of the criteria. The logic behind using two different methods is to compare the rankings of alternatives. If the ranking of alternatives will come out same then it will validate the true nature of ranking. Entropy method is an important method for allocation of weights when no preference is originally given to the criteria.

3.10.3.2 Entropy Method

Entropy method was originally proposed by Shannon in 1948. An extensive use of entropy method has been seen in the literature for evaluating the weights of the indicators. For example, Hsu & Hsu (2008) used the entropy method in assigning the weight of each criterion for medical information system vendors. This method has also been used in assessing the quality of information technology. Liu et al. (2010) also applied this Entropy theory in water quality assessment to deduce the weight of indicators. Zou et al. (2006) also used this Entropy method in the assessment of the water quality for three reservoir areas. Shanian and Savadogo (2009) have shown that the entropy is an appropriate method. The steps of the entropy weight method are as follows.

Step 1:

Initial matrix after range standardization is being used to apply the Entropy method. This method starts with the range standardization step as in Eq 12.

Step 2:

In this step, the following formula is used to calculate the values of f_{ij} for all criteria $i = 1, 2\ldots\ldots m$ and for all alternatives $j = 1, 2\ldots.n$

$$f_{ij} = \frac{1+x_{ij}^{*}}{\sum_{i=1}^{i=m}(1+x_{ij}^{*})} \qquad \text{Eq 15}$$

Step 3:

In this step the formula for H_j is applied. The previous values of f_{ij} will be used for the calculation of H_j

$$H_j = - \left(\sum_{i=1}^{i=m} (f_{ij} * ln\ f_{ij}) \right) \qquad \text{Eq 16}$$

for all $i = 1,2\ldots\ldots m$ and j = $1,2,3\ldots\ldots\ldots n$ .In this formula H_j provides the amount of variation present in each criterion.

Step 4:

In this step, the application of the formula is:

$$G_j = 1 - H_j \qquad \text{Eq 17}$$

This formula computes the degree of deviation. It is clear from the last equation that if value of H_j (information loss) is higher then the value of G_j will be smaller but if the value of H_j (information loss) is lower then the value of G_j will be higher. The higher value of G_j means higher value of weight for the particular criterion (j).The weight (w_j) of the criterion is explained in the following step.

Step 5:

The weight of the criterion is given by the following method:

$$w_j = \frac{G_j}{\sum_{j=1}^{j=n} G_j} \qquad \text{Eq 18}$$

The higher value of G_j for each criterion j (j = 1, 2, 3…n) will lead to the higher value of w_j for each criterion. The use of above equation results in different weights for j=1, 2…….n. The weights from Eq18 are used again in the MOORA method as per the Eq 11.

The results obtained from the MOORA method will be verified with the help of the Sensitivity Analysis method.

3.11 Sensitivity Analysis

No doubt, there is uncertainty involved in the values of weights because they are dependent upon the preferences of the decision makers. The perceptions, experiences, and knowledge of different decision makers may bring uncertainty to the assessment method. Therefore, it is better to do the sensitivity analysis of these weights. The results of a sensitivity analysis can be used to validate a model, warn of unrealistic model behavior, point out important assumptions, and help formulate model structure (Smith et al., 2008).

To answer the question**,** "How sensitive is the overall decision to small changes in the weight of critical criterion assigned during the process of ranking?**"** and to validate the model. The concept of sensitivity analysis is used to find out the answer for this question. This analysis is used to find out the robustness of the ranking of alternatives. If the ranking is robust then it suggests the true nature model. Pannell (1997) recommended that the Sensitivity analysis could be very useful in providing the information such as:

1. How robust the optimal solution is with respect to the different parameter values.

2. Under what conditions the optimal solution would change, and

3. How wrong the decision makers would be if the changed circumstances are ignored and the decision is taken to remain with the original optimal strategy or some other strategy.

According to Pannell, this kind of information is extremely valuable in making decisions or recommendation. "If the optimal strategy is robust (insensitive to changes in parameters), this allows confidence in implementing or recommending it" (Pannell, 1997, p.141).

In this research, measures like criticality degree of criterion and sensitivity coefficient of criterion used by (Triantaphyllou &Sánchez, 1997) are constructed. These measures are used to find out how critical a given decision criterion is in ranking the alternatives. To do so, the concept of minimum change Δ in the original weight is introduced. The smallest percentage of change (increase or decrease) which can change the rankings of the alternatives will be the point of interest.

In this process, all other weights will be normalized by using the new weights. The new weight of the system can be calculated by the following Eq 19.

$W_k{}^{*} = W_k + \Delta \boldsymbol{k}$ for all k= 1, 2…n Eq 19

Δk can take the positive value or the negative value. The weights of all the criteria are normalized as per the following Eq 20.

$W_k{}' = W_k{}^{*} / (W_k{}^{*} + \sum_{i=1,2\dots n}^{i \neq k} Wi)$ Eq 20

In general, the criticality degree for a given criterion C_k is denoted by D_k .The value D_k, is the smallest percent change in the value of w_k which would bring a change in the ranking of the management strategies. The sensitivity coefficient of criterion C_k is denoted as Sens (C_k). It is calculated as the reciprocal of its criticality degree D_k. The formula is given in Eq 21

Sens (C_k) = $1/D_k$ Eq 21

If D_k is infeasible (i.e., there is no chance to change any alternative rankings by changing preference weights), then it means Sens (C_k) is of the value equal to zero.

The Sensitivity Analysis will be used for the validation. This method is considered to be a very powerful technique. After the validation, the TQM method, EFQM is used to bring excellence in the BLE by applying RADAR method on all the cause criteria. The method is explained in detail in the following section.

3.12 Why EFQM Model

The reason for adoption of assessment model EFQM out of all other TQM based assessment models is the relevance of dividing the whole set of criteria of BLE into five enablers and four results. The quality aspect is tried to be achieved in a holistic manner by applying the RADAR logic. The RADAR logic in EFQM excellence model helps in bringing continuous improvement. The EFQM excellence model is applied in UK higher education for self-assessment. Dunn and Mathews (2001) and Jackson (1999) discuss the use of EFQM model in health and social care environments also. Such environments are very sensitive towards quality feature to give best services to its users. Hence, in this study, EFQM model is used to improve the quality of BLE which is very sensitive towards the quality feature for satisfying the learning needs, styles and levels of achievement of learners for establishment of long term quality learning experiences. The

RADAR approach is used for all the cause criteria of BLE. This EFQM method provides an easy way to understand the adopted meaningful approach, deployment, assessment and review to achieve the desired result.

3.12.1 EFQM Assessment Model

The European Foundation for Quality Management came in existence in 1988. This comprised of nine elements grouped under five ‘enabler’ criteria (Leadership, Strategy, People, Partnerships and Resources and Processes, Products and Services) and four ‘result’ criteria (Customer Results, People Results, Society Results, and Key Results). The assessment model is displayed in Figure 3.7.

Each criterion is assessed by the RADAR approach for assessment in the EFQM model. RADAR is the acronym for Results, Approach, Deployment, Assessment, and Review. These are explained in Chapter 5. The RADAR logic is a tool that provides a structured approach to question the performance of any organization (www. efqm.org).It can be seen that applying the RADAR logic is a rigorous process which has the potential to achieve desired results providing efforts are continuous and relentless, measurements are timely, and appropriate and learning opportunities are not overlooked.

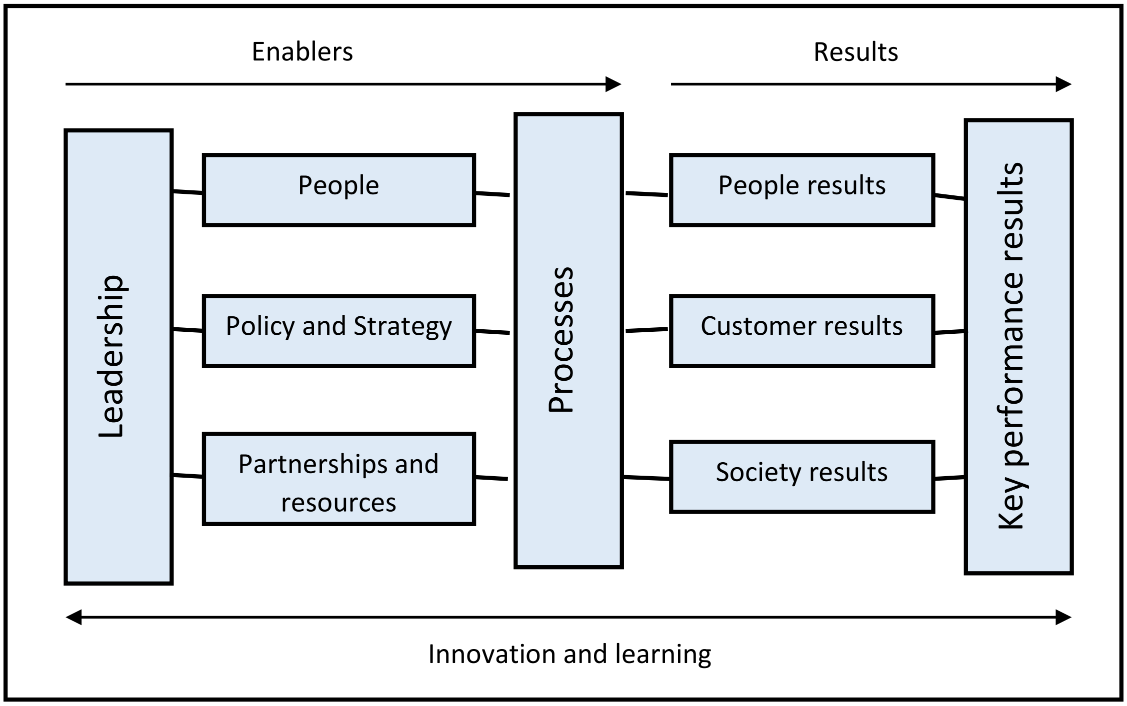


Figure 3.7: The EFQM Model by Schreurs (2006)

The EFQM model is a tool which can be used by organizations for the following purposes:

- As a framework for self-evaluation that helps an organization to identify its strengths and areas for improvement.

- As a way to benchmark with other organizations.

- As a guide to identify areas for improvement.

The Model's 9 boxes represent the criteria against which to assess an organization's progress towards excellence. Out of 9 boxes, 5 are enablers and 4 are results.

The enabler criterion**:**

1. Leadership: It promotes and supports a culture of innovation and continuous improvement.
2. Policy and strategy: It gives career guidance to the staff and the training plan for further support.

3. Partnership and Resources: It manages staff, buildings, materials, and intellectual and information resources on an effective and efficient way.
4. Processes: It takes care of the improvement of learning and teaching processes.

The results criterion**:**

6. Client satisfaction: It meets the needs and expectations of the stakeholders.
7. People satisfaction: It meets the needs and expectations of the learning organization /department responsible for the learning process.
8. Impact on society: It adopts the advanced and innovative learning concepts and e-learning solutions.
9. Impact on the company’s success: It states the business impact of the training of the staff members.

The use of EFQM model will help in following the suggested RADAR method for assessing all the causing criteria with suggested management alternative.

3.13 Summary

To sum up, in this chapter, the research methodology is explained. All the adopted methods: Exploratory Factor Analysis, DEMATEL, MOORA, Sensitivity Analysis and EFQM excellence model are explained in a detailed way. This chapter provides an extensive overview of different adopted analysis and its related activities. The exploratory factor analysis is done on the learner responses through the questionnaire instrument. This analysis results in the extraction of factors and the underlying components of each factor. These underlying components are called criteria.. A multi criteria decision making technique, DEMATEL is applied which will divide the whole set of criteria into the cause group and effect group. After the DEMATEL, another multi criteria decision making technique, the MOORA is applied. This technique helps in ranking the alternatives in an attempt to prioritize the quality development initiatives in the blended learning environment. The validation of ranking is done with the help of sensitivity analysis. Finally, the use of existing models of TQM is recommended in order to develop a superior quality BLE. In the next chapter, the full analysis of the collected data with the help of adopted methodology will be presented.

Chapter 4: Analysis

4.1 Introduction

In this chapter, the whole analysis is shown in a holistic manner. All activities corresponding to proposed methodology are fully analyzed using mathematical decision making techniques. This chapter provides an extensive overview of analysis of adopted methods and its related activities. Initially, it starts with the basic analysis of general questions asked from learners in the questionnaire; for example: age, gender, qualification and number of years of learning in the BLE. The results are represented in the form of Pie charts. Later the full analysis of all the adopted methods (as discussed in previous chapter) are represented in terms of Figures and Tables. Firstly, the basic analysis is explained.

4.2 Basic Analysis

The data collected from the questionnaire responses is primary in nature. The questionnaire consists of total 38 questions. The first four questions are based on the general information about age, gender, qualification and the number of years studied in the BLE. The questions from 5 to 37 are framed for learners to get their responses on the variables which are considered to be very important in the development of the assessment model for the blended learning environment in the field of higher education. The last question asked is: "Highlight one feature of blended learning which has benefitted you the most and one which you think needs to be introduced in future?" It is an open ended question and gives qualitative data. The data can be analyzed using content analysis to derive meaningful information out of it. Thereafter, as per the proposed methodology, the analysis activities will be taken place to complete the quantitative analysis.

4.2.1 Results of Basic Analysis

The first four questions are based on the general information about the age, gender, the qualification, and the number of years studied in the BLE. The total numbers of responses collected are 267.

The preliminary analysis of first question on age is displayed in Table 4.1.

Table 4.1 Frequency Distribution of Age

Age limit	Number of responses	Percentage
18-22 Years	149	56%
22-30 Years	57	21%
30-40 Years	34	13%
40-50 Years	19	7%
50+ Years	8	3%
Total	267	

This Table 4.1 clearly depicts that there are around 90% responses from the category 18-40 years and approximately 10% are from the category 40 years and more. The maximum number of responses (56%) are from the category 18-22 years and the minimum number of responses (3%) are from the category 50 years and more. The following pie chart in the Figure 4.1 is a representation of the information in Table 4.1.

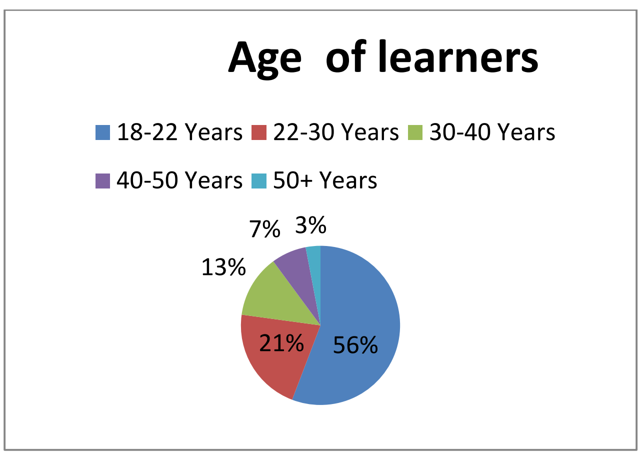


Figure 4.1: Pie chart of Age of Learners

For gender, the following Table 4.2 gives a picture of the result.

Table 4.2 Frequency Distribution of Gender

Gender of learners	No of Responses	Percentage
Male	**118**	44%
Female	**149**	56%

This result indicates that there are more responses from the female category ie.56% and the remaining 44% response are from the male category. The related pie chart in Figure 4.2 is a visual representation of the above information.

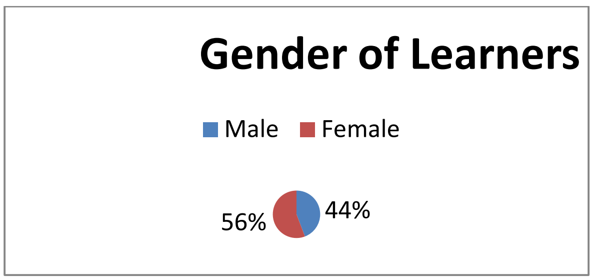


Figure 4.2: Pie chart of Gender of Learners

The following Table indicates data about the qualification.

Table 4.3 Frequency distribution qualification

Qualification	No of responses	Percentage
GCSE/High School	**53**	20%
Bachelor's Degree	**167**	63%
Master's Degree	**40**	15%
PhD	**7**	3%
Total	**267**	100%

According to Table 4.3, the highest number of responses which means around 63% is collected from the learners who are enrolled in the bachelor's degree program .The minimum number of responses, around 3% are from the category PhD. The pie chart in the Figure 4.3 is a depiction of this result.

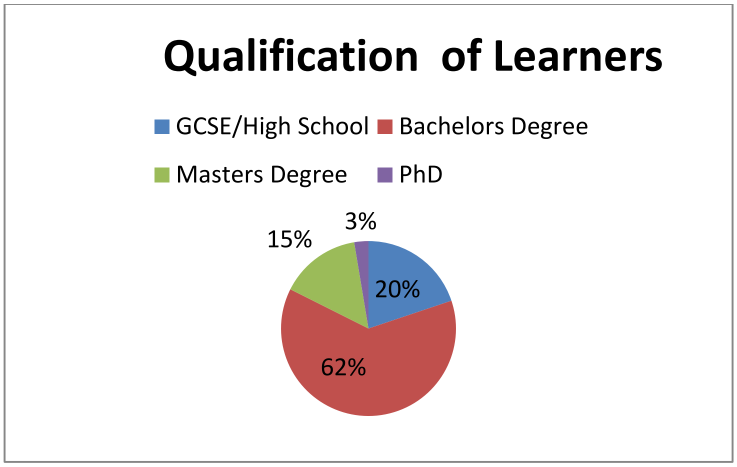


Figure 4.3: Pie chart of Qualification of Learners

For this last question on number of years of experience in the BLE, the following Table 4.4 shows the result.

Table 4.4 Frequency Distribution of No of years Studied in the BLE

No of Years	No of responses	Percentage
1-2 Years	**98**	37%
2-3 Years	**52**	19%
3+ Years	**117**	44%

The maximum number of responses is from those learners who are part of the blended learning environment for more than 3 years.The minimum number of responses is from the category 2-3 years which means only 19% learners are part of the BLE for two to three years.The Figure 4.4 is the visual representation of the results of Table 4.4.

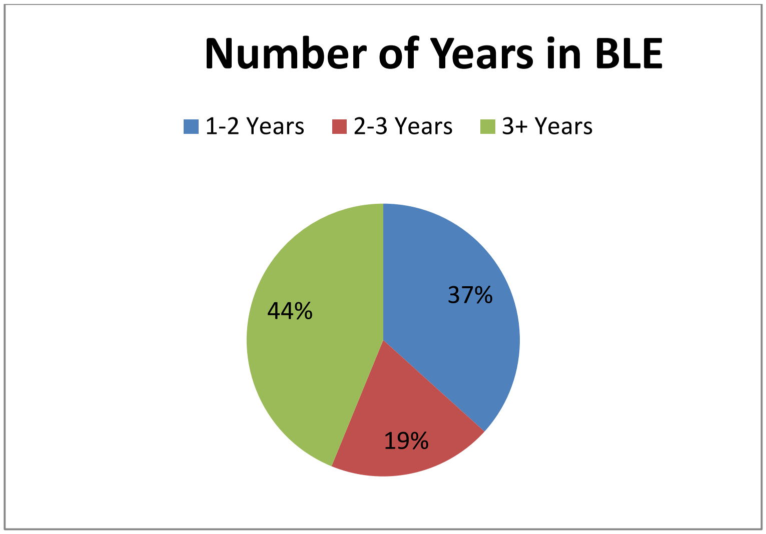


Figure 4.4: Pie Chart of Numbers of Years Studied in BLE

4.3 Results of Exploratory Factor Analysis

Next, exploratory factor analysis is done for 33 variables by using SPSS software. The results of exploratory factor analysis are explained in the following steps:

1-Descriptive Statistics: The first output obtained from the analysis is a table of descriptive statistics for all 33 main variables under investigation. This table shows the values of mean, standard deviation, and the number of respondents who participated in this survey. Significantly, the most important variable affecting the quality of the blended learning environment is the learning through the method of problem based learning. It has the highest mean of **4.041.** The highest value of standard deviation, **1.0212** is seen in variable named “reduction of carbon emission and solving of commute and traffic problems”. The lowest value of standard deviation **0.7794** is seen in variable named “Provision of adequate technical components (synchronous and asynchronous)”. The lowest value shows that this variable is a highly consistent variable.

Table 4.5 Descriptive Statistics

Descriptive Statistics			
	Mean	**Std. Deviation**	**Analysis N**
Right blend of face to face and on line learning activities	3.715	.9184	267
A well-defined course structure	3.764	.8499	267
Problem based learning	4.041	.9269	267
A well explained content	3.333	1.0100	267
The appropriate use of delivery methods	3.790	.9017	267
Personalization of course content and course structure	3.760	.8983	267
Qualification and experience of tutor	3.805	.9692	267
Support of tutor	3.933	.9028	267
Face to Face discussion of student's progress	3.963	.9210	267
An attractive, fully modernized technology	3.730	.8553	267
Provision of adequate technical components (synchronous*and asynchronous*	3.768	.7794	267
Ease of use of learning management system	3.820	.8657	267
An adequate support system	3.906	.8857	267
Reusability of content	3.719	.9216	267
T_24 x7connection	3.906	.8941	267
Prior knowledge of computers	3.801	.9743	267
Feeling of Isolation	3.255	.9669	267
Lack of communication	3.558	.9922	267
Effectiveness of interactions (student-content, student-teacher and student-student)	3.846	.8815	267
Collaboration of various universities	3.678	.9264	267
Feature of Social networking	3.558	.9376	267
Reduction of carbon emission and solving of commute and traffic problems	3.217	1.0212	267
Improvement in the retention rate	3.588	.8942	267
Awarding an authoritative and valid degree / diploma	3.700	.8928	267
Lack of sufficient funds and resources	3.592	.9429	267
Strong organizational leadership	3.685	.9250	267
Clearly defined policies and procedures	3.775	.8283	267
Resistance to embrace change by stakeholders	3.524	.9065	267
Prompt and continuous feedback	3.858	.9783	267
Self-assessment	3.622	.9315	267
Positive return on investments	3.551	.9096	267
Formal and informal kind of assessment and its evaluation	3.610	.8917	267
Evaluation by international quality standards	3.798	.8651	267

2-The Correlation matrix (*R*-Matrix): The second output obtained from the SPSS analysis is the correlation matrix (R-Matrix). A correlation matrix is simply a rectangular array of numbers which gives the idea about the correlation coefficients of paired variables of all involved variables in the survey. The diagonal elements of this correlation coefficient are always 1.This observation gives the idea that all variables relate with themselves perfectly. The off–diagonal elements can take any value between -1 to 1 depending upon the relationship between any two paired variables. This correlation matrix helps the researcher to check the pattern of relationships.

This R matrix can be reduced down to its underlying factors by scanning the significance values and clustering them in a meaningful way. This step helps in the reduction of original data into meaningful factors.

3-Communaliities: Output 3 is a Table 4.6 of communalities and helps in calculating the variability in scores. This table shows the amount of the variance, which was accounted for in the variables by the extracted factors. For example, we see that around 69% of the variance is exhibited by the variable called “lack of communication”, and whereas 67% of the variance is exhibited by the variable “use of appropriate delivery method”. These two variables have the highest values of common variance after extraction.

Table 4.6 Communalities

Communalities		
	Initial	**Extraction**
Right blend of face to face and on line learning activities	1.000	.480
A well-defined course structure	1.000	.581
Problem based learning	1.000	.635
A well explained content	1.000	.445
The appropriate use of delivery methods	1.000	.668
Personalization of course content and course structure	1.000	.438
Qualification and experience of tutor	1.000	.582
Support of tutor	1.000	.597
Face to Face discussion of student's progress	1.000	.556
An attractive, fully modernized technology	1.000	.557
Provision of adequate technical components (synchronous*and asynchronous*	1.000	.592
Ease of use of learning management system	1.000	.588
An adequate support system	1.000	.581
Reusability of content	1.000	.432
T_24 x7connection	1.000	.519
Prior knowledge of computers	1.000	.537
Feeling of Isolation	1.000	.606
Lack of communication	1.000	.685
Effectiveness of interactions (student-content, student-teacher and student-student)	1.000	.545
Collaboration of various universities	1.000	.523
Feature of Social networking	1.000	.425
Reduction of carbon emission and solving of commute and traffic problems	1.000	.507
Improvement in the retention rate	1.000	.470
Awarding an authoritative and valid degree / diploma	1.000	.561
Lack of sufficient funds and resources	1.000	.510
Strong organizational leadership	1.000	.474
Clearly defined policies and procedures	1.000	.496
Resistance to embrace change by stakeholders	1.000	.474
Prompt and continuous feedback	1.000	.580
Self-assessment	1.000	.634
Positive return on investments	1.000	.640
Formal and informal kind of assessment and its evaluation	1.000	.525
Evaluation by international quality standards	1.000	.469

4-Total Variance Explained: The next Table 4.7 represents all factors (components) extractable from the analysis along with their eigenvalues, the percent of variance attributable to each factor, and the cumulative variance of the factors. The columns are labeled mainly as initial eigenvalues, and rotation sums of squared loadings. The eigenvalues help in determining the total number of factors which will remain in the analysis following Kaiser's criterion. The factor whose eigenvalues is less than 1 is excluded from the analysis. From the Table 4.7, it can be concluded that the first factor accounts for 32.713% of the variance, the second 6.296%, the third 5.124%, the fourth 3.478%, and the fifth 3.363 and sixth 3.3%. All these six factors are significant, but all the remaining factors are not significant.

The second column, extraction sums of square loadings, repeats the results of the first column only for the six factors that meet Kaiser's criterion.

The third column, rotation sums of squared loadings, represents the output for the rotated factor solution. One can notice that the proportions of variance explained by six factors look more similar in the rotated solution as compared to the solution without rotation.

Table 4.7 Total Variance

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.795	32.713	32.713	3.964	12.012	12.012
2	2.078	6.296	39.009	3.877	11.748	23.761
3	1.691	5.124	44.133	2.951	8.941	32.702
4	1.148	3.478	47.611	2.397	7.265	39.967
5	1.110	3.363	50.973	2.379	7.210	47.177
6	1.089	3.300	54.273	2.342	7.096	54.273
7	.990	3.000	57.272			
8	.913	2.765	60.038			
9	.866	2.625	62.663			
10	.832	2.521	65.184			
11	.814	2.467	67.651			
12	.806	2.443	70.094			
13	.722	2.188	72.283			
14	.718	2.175	74.458			
15	.649	1.966	76.424			
16	.625	1.893	78.317			
17	.610	1.847	80.164			
18	.588	1.783	81.947			
19	.541	1.639	83.586			
20	.525	1.591	85.177			
21	.498	1.508	86.686			
22	.485	1.470	88.156			
23	.455	1.380	89.535			
24	.426	1.292	90.827			
25	.402	1.218	92.045			
26	.391	1.184	93.230			
27	.371	1.123	94.353			
28	.354	1.073	95.426			
29	.337	1.020	96.446			
30	.317	.960	97.406			
31	.292	.885	98.291			
32	.284	.861	99.152			
33	.280	.848	100.000			

5-Scree Plot: The scree plot is a chart which contains variables: eigenvalues and the number of extracted factors. The variable: eigenvalue is plotted on the y axis and the variable: extracted factor is plotted on the x axis. The graph is really important for determining how many factors to retain in the analysis. The point where the curve begins to flatten out is really of great importance. It can be seen that the curve starts to flatten after factor 6. It can be easily noticed also that factor

7 has an eigenvalue, which is less than 1. Thus, only six factors are the important factors and are retained in the analysis.

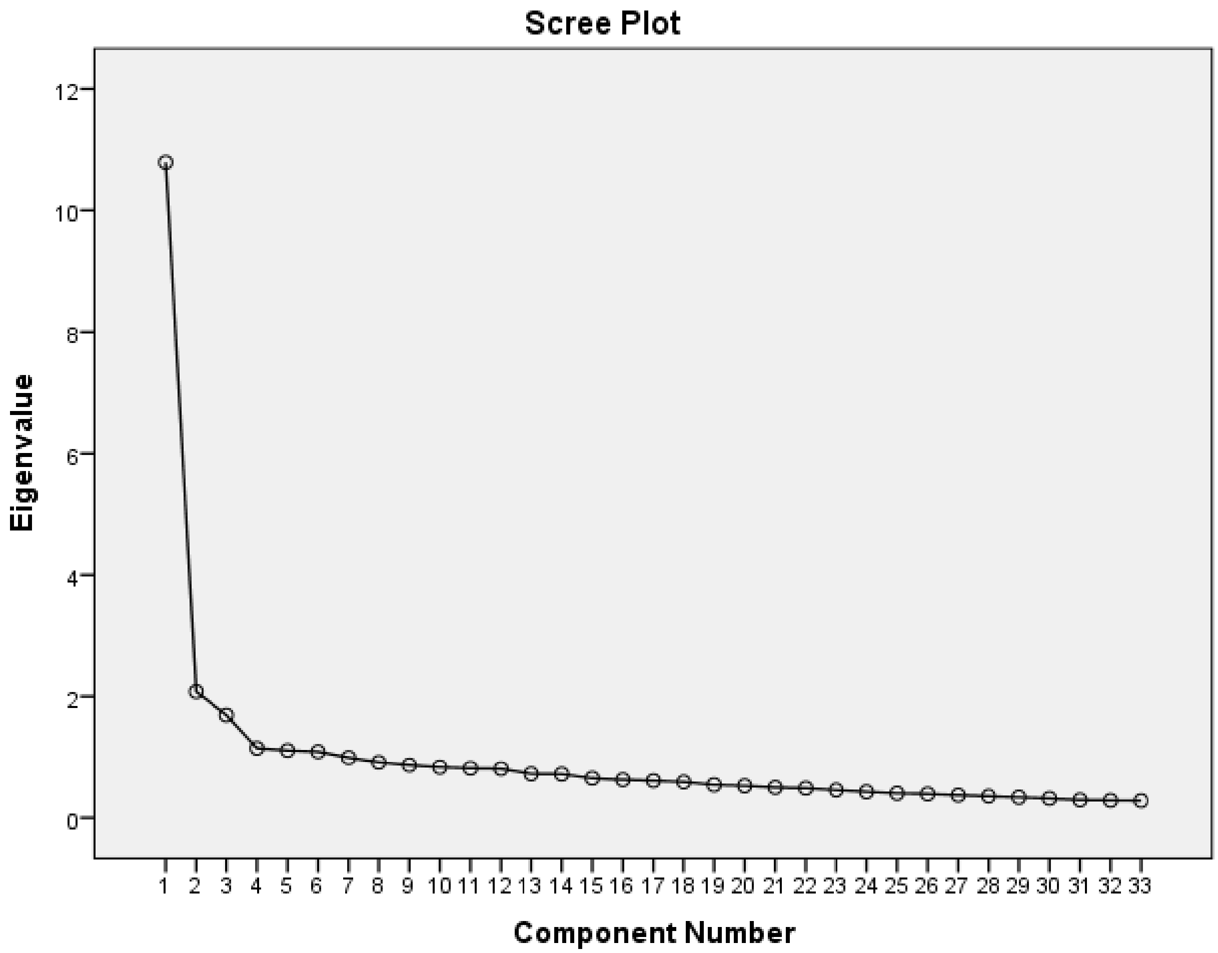


Figure 4.5: Scree Plot

6-Component (factor) Matrix: The Table 4.8 below shows the loadings of the thirty-three variables/criteria on the six factors extracted. These are the correlations between the variables and the unrotated factor components. The higher the absolute value of the loading, the more the variable contributes to the factor. If the value of loading is less than 0.5, then that is not significant.

Table 4.8 Component Matrix

	Component					
	1	2	3	4	5	6
P_Right blend	.610	.058	.195	.236	-.052	.088
P_ course structure	.621	.091	.370	.195	.058	.094
P_ problem based	.749	.101	.193	.124	.095	.049
P_course content	.044	.373	.154	.181	-.257	.427
P_ use of delivery	.602	.131	.190	.225	-.074	.442
P_ Personalization	.443	.332	.107	.099	.024	.332
P_experience	.430	.398	.038	.016	.152	.462
P_ Support tutor	.527	.269	.199	-.125	.235	.368
P_ Face to Face	.355	.405	.239	-.231	.360	.161
T_ tech infrastructure	.261	.193	.634	.156	.100	.124
T_ ade synch ,asynh	.179	.176	.680	.243	-.070	.044
T_ Ease of LMS	.246	.146	.578	-.113	.321	.238
T_adeq support	.472	.180	.522	.084	.199	.083
T_ Reusabecont	.250	.458	.284	.166	.149	.170
T_24 x7connection	.210	.093	.612	.104	.158	.238
T_computer know	.239	.012	.214	.220	.121	.609
S_Isolation	.025	.152	.135	.052	.738	.130
S_Lesscommunication	.049	-.038	.073	.166	.795	.126
S_Eff interactions	.452	.180	.204	.171	.482	-.070
S_collaboration	.179	.225	.156	.615	.111	.157
S_ networking	-.075	.461	.188	.255	.252	.208
S_lowcarbon	-.173	.352	.248	.478	-.034	.248
O_ improved ret	.248	.247	.300	.460	.187	.102
O_AwardingDeg	.311	.334	.086	.533	-.010	.246
O_ Lack funds	.083	.195	.059	.276	.338	.520
O_Strong leadership	.000	.585	.201	.126	.010	.274
O_defpolicies	.341	.205	.075	.527	.229	.050
O_Resisto change	.060	.315	.182	.097	.270	.506
E_Prompt feedb	.450	.387	.397	.083	.245	-.063
E_ownership	.260	.673	.223	.167	.158	-.106
E_ positive return	.191	.739	.043	.208	.007	.106
E_formal informal	.211	.496	-.049	.437	.127	.161
E_international quality	.196	.566	.140	.246	.045	.169

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 15 iterations.

7-Rotated Component (factor) Matrix: In factor analysis, rotation of matrix is done to reduce the number factors on which the variables under investigation have higher loadings. The rotation of the matrix helps in making the interpretation of the analysis easier. Moreover, a rotated factor matrix is really helpful for the researcher to group factors in terms of high loadings.

By looking at the Table 4.9 below, we can see that the problem based learning, a well-defined course structure, a right blend of face-to-face and online activities, the appropriate use of delivery methods, support of tutor to achieve the learning goals, personalization of course content, and course structure are loaded more than 0.5 on factor 1 while positive return on investments on mass adoption, strong leadership , self-assessment and evaluation by international standards are loaded more than 0.5 on component 2.

Moreover, provision of adequate technical components (synchronous and asynchronous), modernized technology equipped infrastructure, ease of use of learning management system, an adequate online support system (e-library, online orientation and expert online communication, technology and availability of communication services (24/7) are loaded on factor 3, while collaboration with international universities, awarding an authoritative degree, and clearly defined policies and procedures are loaded on factor 4. In addition, lack of communication and feeling of isolation are loaded on factor 5.

At last, the variables like prior knowledge of computers, lack of sufficient funds and resources, and resistance to embrace change by stakeholders are loaded on factor 6.The software SPSS is predicting that there is a strong possibility of relationship between the variables and factors.

Table 4.9 Rotated Component Matrix

Rotated Component Matrix						
	Component					
	1	2	3	4	5	6
Real problem based learning	0.749					
A well-defined course structure	0.621					
Right blend of face to face and online learning activities	0.61					
The appropriate use of delivery methods	0.602					0.442
Support of tutor to achieve the learning goal	0.527					
Prompt and continuous feedback	0.45					
Personalization of course content and course structure	0.443					
Positive return on investments on mass adoption		0.739				
Self-assessment		0.673				
Strong leadership		0.585				
Evaluation by international standards		0.566				
Formal and informal kind of assessment		0.496		0.437		
Face to face discussion of student's performance		0.461				
Reusability of content brings sustainability		0.458				
Social and Networking feature		0.405				
Provision of adequate technical components(synchronous and asynchronous)			0.68			
Modernized technology equipped infrastructure			0.634			
Availability of communication services (24 times 7)			0.612			
Ease of use of learning management system			0.578			
An adequate online support system (e-library, online orientation and experts online	0.472		0.522			
Collaboration with international universities				0.615		
Awarding an authoritative degree				0.533		
Clearly defined policies and procedures				0.527		
Reduction of carbon emission				0.478		
Improvement of retention rate by providing more flexibility				0.46		
Lack of communication					0.795	
Feeling of isolation					0.738	
Effectiveness of interactions (student-student, student- teacher, student- content)	0.452				0.482	
Prior knowledge of computers						0.609
Lack of sufficient funds and resources						0.52
Resistance to embrace change by stakeholders						0.506
Qualification and experience of tutor	0.43					0.462
A well explained content						0.427
Extraction Method: Principal Component Analysis.						

4.3.1 Interpretation of Results of Factor Analysis

Exploratory factor analysis has given 6 factors. These six factors are named depending upon the underlying components:

1. Course structure competence (F1)
2. Assessment and evaluation competence (F2)
3. Technical and technological competence (F3)
4. Organizational competence (F4)
5. Effective communication and interaction competence (F5)
6. Instructor's competence (F6)

The factor 1(F1) is named "Course structure competence" and is dependent upon the following underlying criteria : Problem based learning, A well-defined course structure, Right blend of face-to-face and online learning activities, The appropriate use of delivery methods, Support of tutor to achieve the learning , Prompt and continuous feedback , Personalization of course content, and course structure .

The factor 2 (F2) is named "Assessment and evaluation competence" and the underlying components are: Positive return on investments on mass adoption, Self-assessment, Strong leadership, Evaluation by international standards, Formal and informal kind of assessment, Face-to-face discussion of student's performance, Reusability of content brings sustainability, and Social and networking feature.

The factor 3 (F3)is named "Technical and technological competence" and is dependent upon the following criteria: Provision of adequate technical components (synchronous and asynchronous), Modernized technology equipped infrastructure, Availability of communication services (24/7), Ease of use of learning management system, and finally An adequate online support system (e-library, online orientation and experts online).

The factor 4 (F4) is named "Organizational competence" and is dependent upon the mentioned underlying criteria as: Collaboration with international universities, Awarding an authoritative degree, Clearly defined policies and procedures, Reduction of carbon emission, and Improvement of retention rate by providing more flexibility.

The factor 5 (F5) is named "Effective communication and interaction competence" and is dependent upon the underlying criteria: Lack of communication, Feeling of isolation and Effectiveness of interactions (student-student, student- teacher, student- content).

The factor 6 (F6) is named "Instructor's competence" and is dependent upon the underlying criteria: Prior knowledge of computers, Lack of sufficient funds and resources, Resistance to embrace change by stakeholders, Qualification and experience of tutor, and Well explained content.

All these deduced factors and criteria will play a very important role in order to assess the quality of the BLE. Next, the DEMATEL technique is applied on extracted factors and criteria in order to find the inter relationship. This technique has been used in many different situations to get the interrelationship between the parameters. The DEMATEL technique is applied on the responses of two experienced faculty members. The results of full analysis of the DEMATEL is given in the next section.

4.4 Results of Application of DEMATEL Technique

Two decision makers from academia (experienced instructors in BLE) are consulted and they have given their opinions on the scale of 0 to 4. The influence relationship of all factors by taking any two factors at one time is formed and is shown by the following Table 4.10. The first matrix represents the influence relationship marked by decision maker1:DM1. The second matrix represents the influence relationship marked by decision maker2: DM2. Both these matrices are shown in the following Tables 4.10 and 4.11.

Table 4.10 Opinion of (DM1)

DM1(decision maker1)	F1	F2	F3	F4	F5	F6
F1	0	4	3	3	3	3
F2	3	0	2	3	3	4
F3	4	3	0	3	3	3
F4	3	3	3	0	3	3
F5	3	3	1	3	0	4
F6	3	3	3	3	1	0

Table 4.11 Opinion of (DM2)

DM2(decision maker2)	F1	F2	F3	F4	F5	F6
F1	0	4	4	3	4	2
F2	2	0	2	3	3	4
F3	3	3	0	4	3	3
F4	4	3	4	0	3	4
F5	3	2	1	3	0	4
F6	4	3	3	4	1	0

A mean value of their opinions on the main six factors is done by taking the average value of the corresponding elements of two matrices. The average initial direct influence matrix, Z_{nxn} is formulated by using formula in Eq 2, where Z_{ij} represents the influence of element i on element j. The elements of matrix Z_{6x6} are represented in following Table 4.12.

Table 4.12 Average decision Matrix Z_{6x6}

Z_{6X6}	F1	F2	F3	F4	F5	F6
F1	0	4	3.5	3	3.5	2.5
F2	2.5	0	2	3	3	4
F3	3.5	3	0	3.5	3	3
F4	3.5	3	3.5	0	3	3.5
F5	3	2.5	1	3	0	4
F6	3.5	3	3	3.5	1	0

The six rows and the six columns of Z_{6X6} are added separately .The sum of the six rows is represented as R (sum) and the sum of six columns is represented as C (sum).The results are shown as the following Table 4.13. The calculation of R (sum) and C (sum) is the next step of this method.

Table 4.13 Average Matrix with R (Sum) and C (sum)

Z_{6X6}	F1	F2	F3	F4	F5	F6	R (sum)
F1	0	4	3.5	3	3.5	2.5	16.5
F2	2.5	0	2	3	3	4	14.5
F3	3.5	3	0	3.5	3	3	16
F4	3.5	3	3.5	0	3	3.5	16.5
F5	3	2.5	1	3	0	4	13.5
F6	3.5	3	3	3.5	1	0	14
C (sum)	16	15.5	13	16	13.5	17	

X_{6x6} , Normalized matrix will be calculated by dividing all the elements of the matrix Z_{6X6} by the value 17 since 17 is the maximum value out of the column of R(sum) and the maximum value out of the row of C(sum), i.e., (max (16.5, 17). The results are shown in the Table 4.14.

Table 4.14: Matrix after Division with 17

X_{6x6}	F1	F2	F3	F4	F5	F6
F1	0	0.235294	0.205882	0.176471	0.205882	0.147059
F2	0.147059	0	0.117647	0.176471	0.176471	0.235294
F3	0.205882	0.176471	0	0.205882	0.176471	0.176471
F4	0.205882	0.176471	0.205882	0	0.176471	0.205882
F5	0.176471	0.147059	0.058824	0.176471	0	0.235294
F6	0.205882	0.176471	0.176471	0.205882	0.058824	0

Afterwards, the next step is to calculate the matrix $(I – X)$ which can be easily calculated by subtracting all the elements of matrix X from the identity matrix, I (by using the matrix subtraction method). The members of this matrix are represented in the following Table 4. 15.

Table 4.15 Results of Matrix *(I-X)*

(I-X)	F1	F2	F3	F4	F5	F6
F1	1	-0.2353	-0.2059	-0.1765	-0.2059	-0.1471
F2	-0.1471	1	-0.1176	-0.1765	-0.1765	-0.2353
F3	-0.2059	-0.1765	1	-0.2059	-0.1765	-0.1765
F4	-0.2059	-0.1765	-0.2059	1	-0.1765	-0.2059
F5	-0.1765	-0.1471	-0.0588	-0.1765	1	-0.2353
F6	-0.2059	-0.1765	-0.1765	-0.2059	-0.0588	1

Then the next important step in the DEMATEL technique is to find out the inverse of this matrix *(I- X)*.The excel was used in order to deduce the inverse of this matrix, The elements of *(I-X)^(-1)* are shown in the following Table 4.16.

Table 4.16 Inverse Matrix of $(I - X)$

(I-X)^(-1)	F1	F2	F3	F4	F5	F6
F1	2.41323	1.57482	1.37077	1.56351	1.38761	1.61573
F2	1.38993	2.23192	1.17888	1.41046	1.22618	1.5165
F3	1.55707	1.50559	2.1798	1.55582	1.33981	1.60347
F4	1.59179	1.53917	1.38034	2.41977	1.36758	1.65981
F5	1.33766	1.29022	1.07468	1.3365	2.01322	1.43881
F6	1.42331	1.37657	1.22233	1.42217	1.13849	2.30959

The final mathematical step in this method is to compute the matrix $X*(I - X)^{(-1)}$. This matrix is computed by multiplying all the elements of matrix X by the elements of matrix $(I - X)^{(-1)}$. Excel is used for this. The result of matrix $T = X* (I - X)^{(-1)}$ is displayed in the following Table 4.17.

Table 4.17 Matrix of $T = X* (I - X)^{(-1)}$

$T = X* (I - X)^{(-1)}$	F1	F2	F3	F4	F5	F6
F1	1.4132293	1.574821	1.370766	1.563512	1.387608	1.615728
F2	1.3899283	1.231922	1.178876	1.410465	1.226179	1.516499
F3	1.5570727	1.505594	1.179796	1.555817	1.339815	1.603474
F4	1.5917875	1.539169	1.380341	1.419772	1.367583	1.659806
F5	1.3376572	1.290215	1.074684	1.3365	1.013224	1.438806
F6	1.423307	1.376572	1.222328	1.422167	1.138492	1.309594

The implication of Table 4.17 is significant since it provides the direct and indirect effects of the six main factors (F1 to F6).

The threshold value can be calculated by taking the average value of all the elements of the matrix T. It means the total value of all the elements of Table 26 (49.96311) is divided by total number of 36 elements. The calculation is (49.96311) / 36 = 1.387864. This value 1.387864 is the threshold value. The cells which have a value less than this threshold value can be dropped to remove the negligible effects. The significance of dropping this value is to get rid of the negligible effects between the factors.

The array after dropping the values less than the threshold value turns into the following array of numbers. In the following Table 4.18, all values of colored cells are carried forward for the computation purpose since these colored cell values are more than the threshold value, 1.387864.
Table 4.18 Matrix representing more than Threshold Value as colored cells

	F1	**F2**	**F3**	**F4**	**F5**	**F6**
F1	**1.41323**	**1.57482**	~~**1.37077**~~	**1.56351**	~~**1.38761**~~	**1.61573**
F2	**1.38993**	~~**1.23192**~~	~~**1.17888**~~	**1.41046**	~~**1.22618**~~	**1.5165**
F3	**1.55707**	**1.50559**	~~**1.1798**~~	**1.55582**	~~**1.33981**~~	**1.60347**
F4	**1.59179**	**1.53917**	~~**1.38034**~~	**1.41977**	~~**1.36758**~~	**1.65981**
F5	~~**1.33766**~~	~~**1.29022**~~	~~**1.07468**~~	~~**1.3365**~~	~~**1.01322**~~	**1.43881**
F6	**1.42331**	~~**1.37657**~~	~~**1.22233**~~	**1.42217**	~~**1.13849**~~	~~**1.30959**~~

The sum of rows and the sum of columns are computed and are named as D_i and R_j respectively as per the Eq 6 and Eq 7(explained in Chapter 3). The computations of $D_i + R_j$ and $D_i - R_j$ have resulted in the following array of numbers which are represented in the following Table 4.19.

Table 4.19 Resultant Matrix with $D+R$ and D-R

	F1	F2	F3	F4	F5	F6	sum	$D_i + R_j$	$D_i - R_j$
F1	1.41323	1.57482	1.37077	1.56351	1.38761	1.61573	6.16729	13.5426	-1.208
F2	1.38993	1.23192	1.17888	1.41046	1.22618	1.5165	4.31689	8.93647	-0.3027
F3	1.55707	1.50559	1.1798	1.55582	1.33981	1.60347	6.22196	6.22196	6.22196
F4	1.59179	1.53917	1.38034	1.41977	1.36758	1.65981	6.21053	13.5823	-1.1612
F5	1.33766	1.29022	1.07468	1.3365	1.01322	1.43881	1.43881	1.43881	1.43881
F6	1.42331	1.37657	1.22233	1.42217	1.13849	1.30959	2.84547	10.6798	-4.9888
Sum	7.37532	4.61958	0	7.37173	0	7.83431			

For the sake of convenience, $D_i + R_j$ and $D_i - R_j$ will be written as D + R and $D – R$. The practical implication of deducing the values of $D + R$ and $D – R$ is valuable. The values in $D + R$ column give the idea about the degree of influence of the factors, and the values in $D – R$ column give the idea about the net effect of factor on the other factors.

The factors are displayed with their full names and the corresponding values of $D + R$ and D – R as the direct and indirect effects of factors in the following Table 4.20.

Table 4.20 Results of the DEMATEL on Factors

Factor Name	Factor	D + R	D – R
Course structure Competence	F1	13.5426	-1.208
Assessment and evaluation competence	F2	8.93648	-0.3027
Technical and technological competence	F3	6.22196	6.22196
Organizational competence	F4	13.5823	-1.1612
Effective communication and interaction competence	F5	1.43881	1.43881
Instructor's competence	F6	10.6798	-4.9888

The values of $D + R$ and $D – R$ are represented on XY scatter plot using Excel software in the following Figure 4.6. This graph is called digraph and in this graph, the direction of arrow signifies the direction of influence. The graph is also representing a group of the cause factors and effect factors. The criterion master influencer, master receiver, and most related criterion are also displayed in the same Figure 4.6. The factor F3 (Technical and technological competence) is master influencer as it has highest value of $D - R$. The factor F6 is the master receiver as it has least value of $D - R$. The factors in cause group are F3 and F5. The factors in the effect group are F1, F2, F4 and F6.

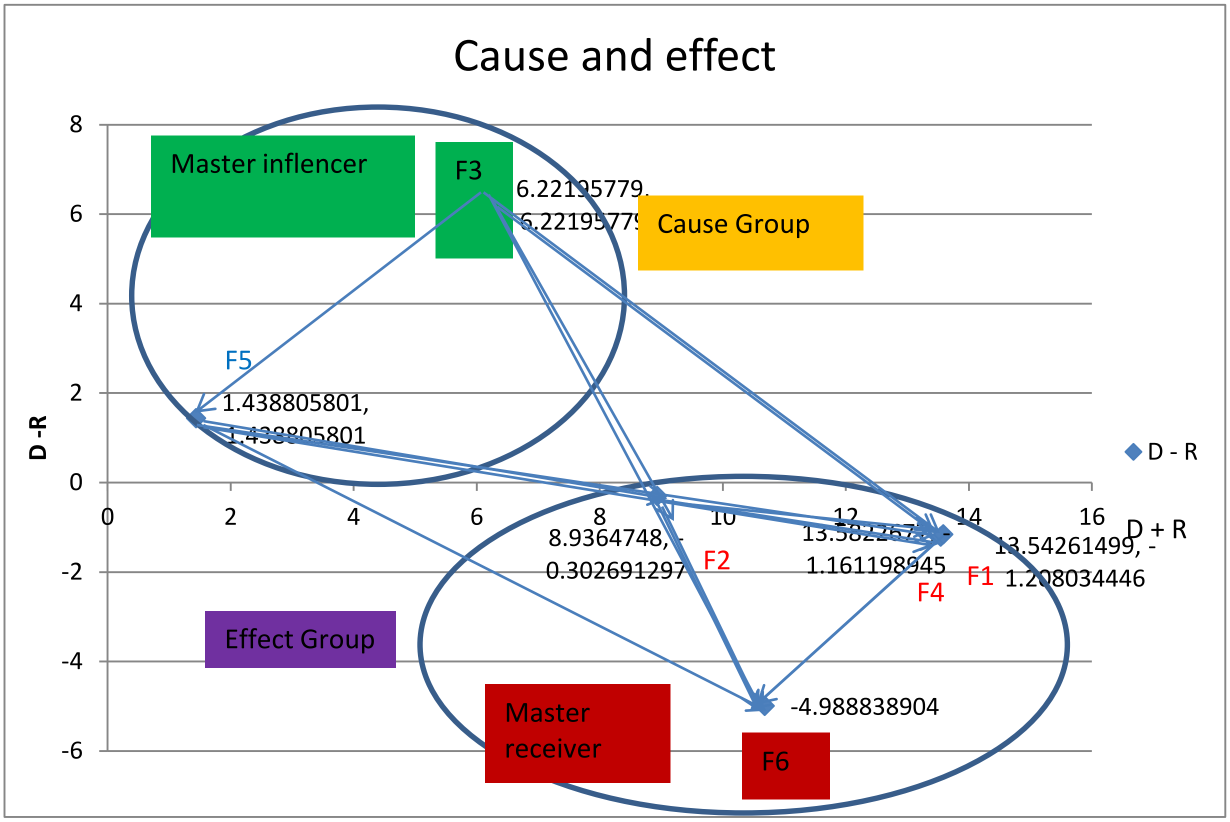


Figure 4.6: The Cause and Effect Diagram

4.4.1 Implication of DEMATEL Technique

The factor F3, the technical and technological competence is the master influencer. This factor is influencing all other factors in a most intense way. The factor F6, Instructor's competence is the master receiver and getting the highest influence from all other factors. The factor F4, organizational competence is the highly related factor. The factor F3 (Technical and technological competence) and F5 (Effective communication competence) are the part of cause group.

This evidence highlights the importance of these two factors while developing the framework for the blended learning environment in the TQM perspective. The factors F1, F2, F4 and F6 belong to the effect group. The values of factor F1 and F4 are very close. Hence on graph, these values are coinciding. An arrow in digraph shows the direction of influence dispatched from the source factor. For example, an arrow from F1 to F2 indicates that factor F1 is dispatching influence on F2.The result of this approach shows the intertwined effects of these factors in the establishment of the superior quality BLE.

In fact, the results have invaluable practical implication since the quality of BLE can be enhanced easily by enhancing the quality of these two cause factors instead of six factors. By adopting this technique, the institutions can achieve the objective of enhancing the quality by putting in minimum efforts, time, money, and other resources. Since they do not need to take any extra action in enhancing the quality of effect factors. The quality of other factors of the effect group is influenced by the quality of cause factors and will automatically be improved without any extra effort. The ideal solution will be to enhance the quality of only cause factors.

4.4.2 Results of DEMATEL on Criteria

Now, the DEMATEL technique is applied on all the 33 criteria lying under the main six factors (from the results of the exploratory factor analysis).

In the next few tables all criteria under factor 1 with 7 components are named as (C_{11}…C_{17}).So C_{11} means criterion 1 under factor1, C_{12} means criterion 2 under factor 1. The criteria C_{ij} implies the *jth* criterion of the *ith* factor where i takes value such that (i = 1, 2, 3, 4, 5, 6) belongs to factor 1 to 6 and j is taking value depending upon the number of components the mentioned factor has.

For factor 1, j is taking value from (1 to 7) since there are 7 components under this factor and are named as C_{11}, C_{12}…..C_{17}. Similarly for factor 2, j is taking value from (1 to 8) and these criteria are named as C_{21}, C_{22}…..C_{28}. For factor F3, j is taking value from (1 to 5) since there are 5 components under this factor and are named as C_{31}, C_{32}, C_{33}…C_{35}. For factor F4, j is taking value from (1 to 5) since there are 5 components under this factor and are named as C_{41}, C_{42}, C_{43}….C_{45}. For factor F5, j is taking value from (1 to 3) since there are 3 components under this factor and are named as C_{51}, C_{52}, C_{53}. For factor F6, j is taking value from (1 to 5) since there are 5 components under this factor and are named as C_{61}, C_{62}……C_{65}.

Two decision makers are consulted from academia who are experienced instructors in BLE and they have given their opinions on the scale of 0 to 4 where 0 signifies no influence and 4 means very strongly. The influence relationship of all criteria by taking any two criteria at one time is shown in the following Tables by Decision Maker1, (DM1). The researcher has tried to split the original Table of 1089 elements from DM1 into four Tables: Table 4.21, Table 4.22, Table 4.23, and Table 4.24.

Table 4.21 Opinions of DM1

DM1(Decision Maker 1)		C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}
Problem based learning	C_{11}	0	3	3	3	2	2	3	4
Well defined course structure	C_{12}	3	0	3	4	2	3	3	4
Right blend of f2f and online learning activities	C_{13}	3	3	0	3	1	3	3	3
Appropriate use of delivery methods	C_{14}	3	3	3	0	1	3	3	1
Support of tutor	C_{15}	3	3	3	3	0	3	3	3
Prompt and continuous feedback	C_{16}	1	1	1	1	1	0	1	4
personalization of course content and course structure	C_{17}	2	2	2	2	2	2	0	3
Return on investments	C_{21}	3	3	3	3	2	2	1	0
Self-assessment	C_{22}	0	3	3	4	3	3	4	4
Strong leadership	C_{23}	3	3	3	3	3	3	3	3
Evaluation by international standards	C_{24}	3	3	3	3	3	2	3	3
Formal and informal kind of assessment	C_{25}	1	3	3	3	2	3	1	3
F2f discussion of student's performance	C_{26}	1	3	3	2	1	3	3	2
Sustainability feature	C_{27}	1	2	1	3	1	1	2	1
Social and Networking feature	C_{28}	0	0	0	0	0	1	0	0
Provision of adequate (synchronous and asynchronous) facility	C_{31}	3	3	3	3	3	3	2	3
Modernized technology equipped infrastructure	C_{32}	3	1	1	3	3	2	3	2
Availability of communication services (24 x 7)	C_{33}	1	1	2	3	1	1	1	1
Ease of use of learning management system	C_{34}	3	3	3	3	1	1	3	1
An adequate online support system (e-library, online orientation and experts online	C_{35}	1	2	3	3	2	2	3	1
Collaboration with international universities	C_{41}	2	1	1	1	1	0	0	0
Awarding an authoritative degree	C_{42}	0	0	1	0	1	1	1	1
Clearly defined policies and procedures	C_{43}	3	3	3	3	3	3	2	3
Reduction of carbon emission	C_{44}	0	0	0	0	0	0	0	0
Improvement of retention rate	C_{45}	1	0	0	1	0	0	0	3
Lack of communication	C_{51}	0	0	0	0	0	0	0	0
Feeling of isolation	C_{52}	0	0	0	0	0	0	0	0
Effectiveness of interactions (student-student, student-teacher, student- content)	C_{53}	2	0	0	0	0	3	0	2
Prior knowledge of computers	C_{61}	3	3	3	2	3	1	3	1
Lack of sufficient funds and resources	C_{62}	1	1	2	3	3	1	2	1
Resistance to embrace change by stakeholders	C_{63}	2	1	3	3	2	0	0	0
Qualification and experience of tutor	C_{64}	3	3	3	3	0	3	3	3
A well explained content	C_{65}	3	3	3	3	3	0	3	3

To be continued…

Table 4.22 Opinions of DM1

DM1(Decision Maker 1)		C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}	C_{33}
Problem based learning	C_{11}	3	2	3	4	1	3	2	3	2	2
Well defined course structure	C_{12}	3	3	3	2	4	4	4	3	3	1
Right blend of f2f and online learning activities	C_{13}	3	2	4	4	3	3	3	3	3	3
Appropriate use of delivery methods	C_{14}	3	2	3	3	3	3	3	3	2	3
Support of tutor	C_{15}	2	3	3	3	3	3	3	3	2	3
Prompt and continuous feedback	C_{16}	3	4	4	1	2	4	1	0	0	0
personalization of course content and course structure	C_{17}	2	2	2	2	3	3	3	3	3	2
Return on investments	C_{21}	3	1	2	1	2	2	1	3	3	2
Self-assessment	C_{22}	0	0	3	3	3	2	3	3	4	3
Strong leadership	C_{23}	3	0	3	3	3	3	3	2	3	3
Evaluation by international standards	C_{24}	3	3	0	3	3	3	2	3	3	2
Formal and informal kind of assessment	C_{25}	4	0	3	0	1	3	2	1	1	1
F2f discussion of student's performance	C_{26}	3	1	2	1	0	2	3	2	2	2
Sustainability feature	C_{27}	1	1	2	3	1	0	0	2	1	2
Social and Networking feature	C_{28}	3	0	1	0	1	1	0	1	0	2
Provision of adequate (synchronous and asynchronous) facility	C_{31}	3	2	2	1	2	2	3	0	3	3
Modernized technology equipped infrastructure	C_{32}	3	0	3	1	1	2	3	3	0	3
Availability of communication services (24 x 7)	C_{33}	4	1	3	2	0	2	3	3	3	0
Ease of use of learning management system	C_{34}	3	1	3	2	0	3	0	3	0	0
An adequate online support system (e-library, online orientation and experts online	C_{35}	4	2	3	2	0	3	3	3	3	3
Collaboration with international universities	C_{41}	3	0	3	0	0	3	1	1	1	1
Awarding an authoritative degree	C_{42}	1	0	3	1	2	3	1	3	1	1
Clearly defined policies and procedures	C_{43}	3	2	3	1	3	2	1	2	1	2
Reduction of carbon emission	C_{44}	1	0	0	0	0	0	0	3	0	0
Improvement of retention rate	C_{45}	3	2	2	0	0	2	0	0	0	0
Lack of communication	C_{51}	3	0	0	0	0	0	0	0	0	0
Feeling of isolation	C_{52}	4	0	0	0	0	0	1	1	0	0
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	3	2	0	0	0	1	2	1	0	0
Prior knowledge of computers	C_{61}	2	0	0	0	0	0	2	3	3	0
Lack of sufficient funds and resources	C_{62}	1	0	1	1	1	2	2	3	3	3
Resistance to embrace change by stakeholders	C_{63}	2	0	2	0	0	0	0	0	3	0
Qualification and experience of tutor	C_{64}	1	2	3	3	3	2	1	2	1	0
A well explained content	C_{65}	4	1	3	3	2	0	3	1	0	0

To be continued…

Table 4.23 Opinions of DM1

DM1(Decision Maker 1)		C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}
Problem based learning	C_{11}	2	3	2	4	4	4	4	1	0	3
Well defined course structure	C_{12}	3	3	3	3	4	4	0	0	0	3
Right blend of f2f and online learning activities	C_{13}	3	3	3	3	3	3	3	0	0	3
Appropriate use of delivery methods	C_{14}	3	3	3	3	3	3	3	0	4	4
Support of tutor	C_{15}	3	3	3	3	3	3	3	0	0	3
Prompt and continuous feedback	C_{16}	1	0	4	4	4	4	1	0	0	3
personalization of course content and course structure	C_{17}	2	2	4	4	3	2	3	0	0	2
Return on investments	C_{21}	2	2	3	2	3	1	1	0	0	2
Self-assessment	C_{22}	3	4	3	1	3	2	3	0	0	0
Strong leadership	C_{23}	2	3	3	3	3	3	2	0	0	2
Evaluation by international standards	C_{24}	3	3	3	3	3	2	2	0	0	2
Formal and informal kind of assessment	C_{25}	1	1	1	3	2	1	3	0	0	3
F2f discussion of student’s performance	C_{26}	1	1	2	2	3	2	2	0	0	0
Sustainability feature	C_{27}	2	1	1	3	3	3	3	1	0	2
Social and Networking feature	C_{28}	0	3	3	1	0	3	1	0	3	3
Provision of adequate (synchronous and asynchronous) facility	C_{31}	2	3	3	3	3	3	3	3	3	3
Modernized technology equipped infrastructure	C_{32}	1	3	3	1	1	3	1	0	0	3
Availability of communication services (24 x 7)	C_{33}	1	3	3	0	1	3	0	3	3	3
Ease of use of learning management system	C_{34}	0	1	3	2	1	1	1	2	0	3
An adequate online support system (e-library, online orientation and experts online	C_{35}	3	0	3	2	1	3	2	0	0	3
Collaboration with international universities	C_{41}	0	0	0	3	1	2	0	0	0	1
Awarding an authoritative degree	C_{42}	0	1	1	0	3	0	0	0	0	0
Clearly defined policies and procedures	C_{43}	1	2	2	3	0	0	0	0	0	0
Reduction of carbon emission	C_{44}	0	0	0	0	0	0	0	0	0	0
Improvement of retention rate	C_{45}	0	0	0	0	0	0	0	0	0	2
Lack of communication	C_{51}	0	0	0	0	0	0	0	0	3	0
Feeling of isolation	C_{52}	0	0	0	0	0	0	0	0	0	0
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0	0	0	0	1	0	2	0	0	0
Prior knowledge of computers	C_{61}	3	3	0	0	0	1	0	0	0	1
Lack of sufficient funds and resources	C_{62}	0	3	3	1	1	3	0	0	0	0
Resistance to embrace change by stakeholders	C_{63}	0	2	2	0	0	3	0	0	3	2
Qualification and experience of tutor	C_{64}	3	1	2	0	2	1	3	0	0	3
A well explained content	C_{65}	0	3	2	0	0	0	0	3	0	3

To be continued…

Table 4.24 Opinions of DM1

DM1(Decision Maker 1)		C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
Problem based learning	C_{11}	0	1	0	4	4
Well defined course structure	C_{12}	1	1	0	3	3
Right blend of f2f and online learning activities	C_{13}	2	2	0	3	3
Appropriate use of delivery methods	C_{14}	2	3	0	1	4
Support of tutor	C_{15}	0	0	3	0	3
Prompt and continuous feedback	C_{16}	1	2	2	2	3
personalization of course content and course structure	C_{17}	1	1	3	1	1
Return on investments	C_{21}	2	0	2	3	2
Self-assessment	C_{22}	4	1	2	1	1
Strong leadership	C_{23}	2	0	2	3	2
Evaluation by international standards	C_{24}	1	1	2	3	3
Formal and informal kind of assessment	C_{25}	2	1	3	2	2
F2f discussion of student's performance	C_{26}	3	1	2	2	3
Sustainability feature	C_{27}	2	1	2	0	0
Social and Networking feature	C_{28}	2	1	1	1	3
Provision of adequate (synchronous and asynchronous) facility	C_{31}	3	2	2	3	4
Modernized technology equipped infrastructure	C_{32}	0	0	1	1	3
Availability of communication services (24 x 7)	C_{33}	0	0	2	0	2
Ease of use of learning management system	C_{34}	0	0	3	0	3
An adequate online support system (e-library, online orientation and experts online	C_{35}	0	0	3	1	3
Collaboration with international universities	C_{41}	0	2	0	0	0
Awarding an authoritative degree	C_{42}	0	0	1	0	0
Clearly defined policies and procedures	C_{43}	0	0	0	0	0
Reduction of carbon emission	C_{44}	0	0	0	0	0
Improvement of retention rate	C_{45}	0	0	3	0	2
Lack of communication	C_{51}	0	0	3	0	0
Feeling of isolation	C_{52}	0	0	0	0	0
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0	0	0	0	0
Prior knowledge of computers	C_{61}	0	0	0	1	3
Lack of sufficient funds and resources	C_{62}	0	0	2	0	0
Resistance to embrace change by stakeholders	C_{63}	0	0	0	0	0
Qualification and experience of tutor	C_{64}	3	0	0	0	3
A well explained content	C_{65}	0	0	0	0	0

Next 4 tables, Table 4.25, Table 4.26, Table 4.27, and Table 4.28 represent opinions of DM2.
Table 4.25 Decision Matrix by DM2

DM2(Decision maker 2)		C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}
Problem based learning	C_{11}	0	1	3	3	2	2	3	3	3	1
Well defined course structure	C_{12}	3	0	4	4	2	3	3	3	3	2
Right blend of f2f and online learning activities	C_{13}	3	3	0	4	3	3	0	1	3	1
Appropriate use of delivery methods	C_{14}	3	2	3	0	3	3	2	2	3	1
Support of tutor	C_{15}	3	3	4	3	0	3	4	3	2	2
Prompt and continuous feedback	C_{16}	3	3	2	2	3	0	3	2	3	1
personalization of course content and course structure	C_{17}	3	3	3	4	4	3	0	2	1	2
Return on investments	C_{21}	2	0	0	2	0	0	0	0	3	2
Self-assessment	C_{22}	0	3	3	3	3	3	4	3	0	0
Strong leadership	C_{23}	2	1	2	3	3	3	2	3	3	0
Evaluation by international standards	C_{24}	3	3	2	3	2	2	1	2	3	1
Formal and informal kind of assessment	C_{25}	4	3	3	3	2	3	2	2	3	1
F2f discussion of student's performance	C_{26}	2	3	2	2	3	2	2	2	3	2
Sustainability feature	C_{27}	2	2	2	1	1	1	2	1	1	2
Social and Networking feature	C_{28}	2	2	3	3	3	2	3	2	3	2
Provision of adequate (synchronous and asynchronous) facility	C_{31}	2	2	4	2	3	2	2	2	3	3
Modernized technology equipped infrastructure	C_{32}	2	3	2	3	2	2	3	3	3	3
Availability of communication services (24 x 7)	C_{33}	1	1	4	2	2	3	2	3	3	2
Ease of use of learning management system	C_{34}	2	2	3	3	2	3	3	3	3	3
An adequate online support system (e-library, online orientation and experts online	C_{35}	2	2	2	3	2	3	2	2	3	2
Collaboration with international universities	C_{41}	3	2	3	2	2	3	2	2	3	2
Awarding an authoritative degree	C_{42}	3	3	2	3	3	3	3	3	1	2
Clearly defined policies and procedures	C_{43}	3	2	2	2	3	2	2	3	3	3
Reduction of carbon emission	C_{44}	2	1	1	1	1	1	1	1	1	1
Improvement of retention rate	C_{45}	3	3	2	3	2	2	3	3	3	3
Lack of communication	C_{51}	3	2	3	2	2	2	2	2	3	2
Feeling of isolation	C_{52}	2	2	2	3	2	2	1	2	3	1
Effectiveness of interactions (student - student, student- teacher, student-content)	C_{53}	3	3	3	3	4	3	4	3	3	3
Prior knowledge of computers	C_{61}	3	3	2	3	3	2	2	2	2	3
Lack of sufficient funds and resources	C_{62}	2	2	3	2	2	2	2	3	2	2
Resistance to embrace change by stakeholders	C_{63}	2	2	3	2	2	3	2	2	2	2
Qualification and experience of tutor	C_{64}	3	4	3	4	4	4	4	4	2	3
A well explained content	C_{65}	4	3	4	3	4	3	3	3	4	3

To be continued…

Table 4.26 Decision Matrix by DM2

DM2		C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}	C_{33}	C_{34}	C_{35}
Problem based learning	C_{11}	3	3	2	2	2	3	3	3	2	2
Well defined course structure	C_{12}	4	4	3	4	3	3	3	3	2	2
Right blend of f2f and online learning activities	C_{13}	4	3	4	3	3	4	4	4	2	2
Appropriate use of delivery methods	C_{14}	3	3	3	2	3	3	3	2	2	2
Support of tutor	C_{15}	2	3	4	3	3	3	2	2	2	2
Prompt and continuous feedback	C_{16}	3	2	4	3	3	3	2	2	2	2
personalization of course content and course structure	C_{17}	4	2	3	4	3	2	2	0	2	2
Return on investments	C_{21}	0	0	0	0	0	2	2	0	0	3
Self-assessment	C_{22}	3	3	3	2	3	3	3	3	3	3
Strong leadership	C_{23}	2	1	2	2	1	1	3	3	1	3
Evaluation by international standards	C_{24}	0	2	3	2	3	2	2	1	2	2
Formal and informal kind of assessment	C_{25}	2	0	2	2	2	2	3	2	3	2
F2f discussion of student's performance	C_{26}	2	2	0	3	2	3	3	3	3	3
Sustainability feature	C_{27}	1	1	2	0	1	2	2	2	2	2
Social and Networking feature	C_{28}	2	2	2	1	0	3	3	2	2	2
Provision of adequate (synchronous and asynchronous) facility	C_{31}	2	3	2	3	3	0	2	2	2	3
Modernized technology equipped infrastructure	C_{32}	2	2	2	2	3	2	0	2	3	3
Availability of communication services (24 x 7)	C_{33}	3	2	2	2	3	2	2	0	3	2
Ease of use of learning management system	C_{34}	2	3	3	2	2	3	3	2	0	3
An adequate online support system (e-library, online orientation and experts online	C_{35}	3	3	2	2	3	3	2	2	2	0
Collaboration with international universities	C_{41}	2	3	2	2	2	2	3	2	2	2
Awarding an authoritative degree	C_{42}	3	3	2	3	3	3	2	3	3	3
Clearly defined policies and procedures	C_{43}	3	3	2	3	2	3	3	2	2	3
Reduction of carbon emission	C_{44}	1	1	1	1	1	2	1	1	1	1
Improvement of retention rate	C_{45}	2	3	3	2	2	2	2	2	3	3
Lack of communication	C_{51}	2	3	2	2	2	2	2	3	2	2
Feeling of isolation	C_{52}	2	2	1	2	1	2	2	1	2	2
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	3	4	4	3	4	3	3	2	3	4
Prior knowledge of computers	C_{61}	3	3	2	2	2	3	2	3	2	2
Lack of sufficient funds and resources	C_{62}	3	2	2	3	3	2	2	2	2	3
Resistance to embrace change by stakeholders	C_{63}	3	2	2	2	3	2	2	3	2	2
Qualification and experience of tutor	C_{64}	3	4	4	3	3	4	4	4	3	3
A well explained content	C_{65}	4	4	3	3	3	3	3	3	3	4

To be continued…

Table 4.27: Decision Matrix by DM2

DM2(Decision maker 2)		C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}
Problem based learning	C_{11}	3	2	2	2	2	2	2	3
Well defined course structure	C_{12}	3	3	3	2	3	1	1	3
Right blend of f2f and online learning activities	C_{13}	2	2	2	3	3	1	3	4
Appropriate use of delivery methods	C_{14}	3	3	2	2	2	1	2	3
Support of tutor	C_{15}	3	2	2	2	2	2	2	2
Prompt and continuous feedback	C_{16}	3	2	2	2	2	1	1	2
personalization of course content and course structure	C_{17}	3	2	2	1	1	1	1	2
Return on investments	C_{21}	3	1	1	1	1	1	1	0
Self-assessment	C_{22}	3	1	3	2	3	0	0	0
Strong leadership	C_{23}	3	2	3	1	1	3	1	2
Evaluation by international standards	C_{24}	3	2	3	2	1	2	1	2
Formal and informal kind of assessment	C_{25}	2	2	3	2	2	3	2	2
F2f discussion of student’s performance	C_{26}	3	2	2	2	3	2	2	2
Sustainability feature	C_{27}	1	1	1	2	2	2	2	2
Social and Networking feature	C_{28}	2	3	3	2	2	2	2	2
Provision of adequate (synchronous and asynchronous) facility	C_{31}	3	2	2	2	3	3	3	2
Modernized technology equipped infrastructure	C_{32}	2	2	2	3	3	3	2	3
Availability of communication services (24 x 7)	C_{33}	3	3	3	2	2	2	2	2
Ease of use of learning management system	C_{34}	3	2	2	2	2	3	3	2
An adequate online support system (e-library, online orientation and experts online	C_{35}	3	2	1	2	1	3	2	1
Collaboration with international universities	C_{41}	0	2	2	3	2	2	2	2
Awarding an authoritative degree	C_{42}	2	0	3	2	2	2	2	3
Clearly defined policies and procedures	C_{43}	2	2	0	3	2	2	2	3
Reduction of carbon emission	C_{44}	1	1	1	0	2	1	1	1
Improvement of retention rate	C_{45}	3	2	2	2	0	2	3	2
Lack of communication	C_{51}	2	2	2	2	2	0	2	3
Feeling of isolation	C_{52}	2	2	1	1	2	1	0	0
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	3	3	3	3	3	3	3	0
Prior knowledge of computers	C_{61}	2	3	3	3	2	2	2	2
Lack of sufficient funds and resources	C_{62}	2	3	2	2	2	3	3	2
Resistance to embrace change by stakeholders	C_{63}	2	3	2	3	3	3	2	3
Qualification and experience of tutor	C_{64}	4	4	3	3	4	4	2	2
A well explained content	C_{65}	3	3	3	4	3	3	2	2

To be continued…

Table 4.28 Opinions of Decision Maker 2

DM2(Decision maker 2)		C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
Problem based learning	C_{11}	2	2	2	3	3
Well defined course structure	C_{12}	2	1	2	0	3
Right blend of f2f and online learning activities	C_{13}	3	3	2	2	3
Appropriate use of delivery methods	C_{14}	2	2	2	2	2
Support of tutor	C_{15}	3	2	3	2	3
Prompt and continuous feedback	C_{16}	2	1	2	2	2
personalization of course content and course structure	C_{17}	1	1	1	2	1
Return on investments	C_{21}	0	4	2	2	0
Self-assessment	C_{22}	3	1	1	1	1
Strong leadership	C_{23}	1	1	1	1	1
Evaluation by international standards	C_{24}	2	1	1	1	1
Formal and informal kind of assessment	C_{25}	1	2	1	2	1
F2f discussion of student’s performance	C_{26}	2	3	1	2	2
Sustainability feature	C_{27}	1	2	1	2	2
Social and Networking feature	C_{28}	3	2	2	2	1
Provision of adequate (synchronous and asynchronous) facility	C_{31}	2	2	3	3	1
Modernized technology equipped infrastructure	C_{32}	2	2	3	2	1
Availability of communication services (24 x 7)	C_{33}	3	3	2	2	2
Ease of use of learning management system	C_{34}	2	2	2	1	2
An adequate online support system (e-library, online orientation and experts online	C_{35}	1	2	1	2	1
Collaboration with international universities	C_{41}	2	3	2	2	2
Awarding an authoritative degree	C_{42}	2	2	2	3	2
Clearly defined policies and procedures	C_{43}	2	2	3	2	2
Reduction of carbon emission	C_{44}	1	2	1	1	1
Improvement of retention rate	C_{45}	2	2	2	2	2
Lack of communication	C_{51}	2	2	2	2	2
Feeling of isolation	C_{52}	1	2	2	1	1
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0	3	2	2	2
Prior knowledge of computers	C_{61}	0	0	3	2	2
Lack of sufficient funds and resources	C_{62}	2	0	0	3	2
Resistance to embrace change by stakeholders	C_{63}	2	2	0	0	2
Qualification and experience of tutor	C_{64}	3	3	2	0	3
A well explained content	C_{65}	1	2	0	4	0

Next 4 tables, Table 4.29, Table 4.30, Table 4.31and Table 4.32 are representing the average opinions of decision makers, DM1 and DM2.In order to find the average opinions, the first mathematical step is to find the average value of opinions of two decision makers. This average value is calculated for the corresponding values of criteria. For example, to get the average value of C_{12} criterion, the values from decision maker1 and decision maker 2 are added and an average is taken. The decision maker1 and decision maker 2 have given values for criterion C_{12} as 3 and 1 respectively. The average value of the opinions comes out to be (3+1)/2 = 2.

Table 4.29, Table 4.30, Table 4.31, and Table 4.32 also displays the total of all columns and rows. The sums of rows and columns are calculated and are represented by R (sum) and C (sum) respectively. The maximum value out of R (sum) and C (sum) is calculated.

Table 4.29 Average values of opinions of DM1, DM2

Average of DM1 and DM2		C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}
Problem based learning	C_{11}	0.0	2.0	3.0	3.0	2.0	2.0	3.0	3.5	3.0	1.5
Well defined course structure	C_{12}	3.0	0.0	3.5	4.0	2.0	3.0	3.0	3.5	3.0	2.5
Right blend of f2f and online learning activities	C_{13}	3.0	3.0	0.0	3.5	2.0	3.0	1.5	2.0	3.0	1.5
Appropriate use of delivery methods	C_{14}	3.0	2.5	3.0	0.0	2.0	3.0	2.5	1.5	3.0	1.5
Support of tutor	C_{15}	3.0	3.0	3.5	3.0	0.0	3.0	3.5	3.0	2.0	2.5
Prompt and continuous feedback	C_{16}	2.0	2.0	1.5	1.5	2.0	0.0	2.0	3.0	3.0	2.5
personalization of course content and course structure	C_{17}	2.5	2.5	2.5	3.0	3.0	2.5	0.0	2.5	1.5	2.0
Return on investments	C_{21}	2.5	1.5	1.5	2.5	1.0	1.0	0.5	0.0	3.0	1.5
Self-assessment	C_{22}	0.0	3.0	3.0	3.5	3.0	3.0	4.0	3.5	0.0	0.0
Strong leadership	C_{23}	2.5	2.0	2.5	3.0	3.0	3.0	2.5	3.0	3.0	0.0
Evaluation by international standards	C_{24}	3.0	3.0	2.5	3.0	2.5	2.0	2.0	2.5	3.0	2.0
Formal and informal kind of assessment	C_{25}	2.5	3.0	3.0	3.0	2.0	3.0	1.5	2.5	3.5	0.5
F2f discussion of student's performance	C_{26}	1.5	3.0	2.5	2.0	2.0	2.5	2.5	2.0	3.0	1.5
Sustainability feature	C_{27}	1.5	2.0	1.5	2.0	1.0	1.0	2.0	1.0	1.0	1.5
Social and Networking feature	C_{28}	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.0	3.0	1.0
Provision of adequate (synchronous and asynchronous) facility	C_{31}	2.5	2.5	3.5	2.5	3.0	2.5	2.0	2.5	3.0	2.5
Modernized technology equipped infrastructure	C_{32}	2.5	2.0	1.5	3.0	2.5	2.0	3.0	2.5	3.0	1.5
Availability of communication services (24 x 7)	C_{33}	1.0	1.0	3.0	2.5	1.5	2.0	1.5	2.0	3.5	1.5
Ease of use of learning management system	C_{34}	2.5	2.5	3.0	3.0	1.5	2.0	3.0	2.0	3.0	2.0
An adequate online support system (e-library, online orientation and experts online	C_{35}	1.5	2.0	2.5	3.0	2.0	2.5	2.5	1.5	3.5	2.0
Collaboration with international universities	C_{41}	2.5	1.5	2.0	1.5	1.5	1.5	1.0	1.0	3.0	1.0
Awarding an authoritative degree	C_{42}	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0	1.0	1.0
Clearly defined policies and procedures	C_{43}	3.0	2.5	2.5	2.5	3.0	2.5	2.0	3.0	3.0	2.5
Reduction of carbon emission	C_{44}	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5
Improvement of retention rate	C_{45}	2.0	1.5	1.0	2.0	1.0	1.0	1.5	3.0	3.0	2.5
Lack of communication	C_{51}	1.5	1.0	1.5	1.0	1.0	1.0	1.0	1.0	3.0	1.0
Feeling of isolation	C_{52}	1.0	1.0	1.0	1.5	1.0	1.0	0.5	1.0	3.5	0.5
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	2.5	1.5	1.5	1.5	2.0	3.0	2.0	2.5	3.0	2.5
Prior knowledge of computers	C_{61}	3.0	3.0	2.5	2.5	3.0	1.5	2.5	1.5	2.0	1.5
Lack of sufficient funds and resources	C_{62}	1.5	1.5	2.5	2.5	2.5	1.5	2.0	2.0	1.5	1.0
Resistance to embrace change by stakeholders	C_{63}	2.0	1.5	3.0	2.5	2.0	1.5	1.0	1.0	2.0	1.0
Qualification and experience of tutor	C_{64}	3.0	3.5	3.0	3.5	2.0	3.5	3.5	3.5	1.5	2.5
A well explained content	C_{65}	3.5	3.0	3.5	3.0	3.5	1.5	3.0	3.0	4.0	2.0
Total C(sum)		69.0	67.0	74.5	78.5	64.5	66.5	66.5	70.0	85.5	51.0

To be continued…

Table 4.30 Average values of opinion DM1 and DM2

Average of DM1 and DM2		C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}	C_{33}	C_{34}	C_{35}
Problem based learning	C_{11}	3.0	3.5	1.5	2.5	2.0	3.0	2.5	2.5	2.0	2.5
Well defined course structure	C_{12}	3.5	3.0	3.5	4.0	3.5	3.0	3.0	2.0	2.5	2.5
Right blend of f2f and online learning activities	C_{13}	4.0	3.5	3.5	3.0	3.0	3.5	3.5	3.5	2.5	2.5
Appropriate use of delivery methods	C_{14}	3.0	3.0	3.0	2.5	3.0	3.0	2.5	2.5	2.5	2.5
Support of tutor	C_{15}	2.5	3.0	3.5	3.0	3.0	3.0	2.0	2.5	2.5	2.5
Prompt and continuous feedback	C_{16}	3.5	1.5	3.0	3.5	2.0	1.5	1.0	1.0	1.5	1.0
personalization of course content and course structure	C_{17}	3.0	2.0	3.0	3.5	3.0	2.5	2.5	1.0	2.0	2.0
Return on investments	C_{21}	1.0	0.5	1.0	1.0	0.5	2.5	2.5	1.0	1.0	2.5
Self-assessment	C_{22}	3.0	3.0	3.0	2.0	3.0	3.0	3.5	3.0	3.0	3.5
Strong leadership	C_{23}	2.5	2.0	2.5	2.5	2.0	1.5	3.0	3.0	1.5	3.0
Evaluation by international standards	C_{24}	0.0	2.5	3.0	2.5	2.5	2.5	2.5	1.5	2.5	2.5
Formal and informal kind of assessment	C_{25}	2.5	0.0	1.5	2.5	2.0	1.5	2.0	1.5	2.0	1.5
F2f discussion of student's performance	C_{26}	2.0	1.5	0.0	2.5	2.5	2.5	2.5	2.5	2.0	2.0
Sustainability feature	C_{27}	1.5	2.0	1.5	0.0	0.5	2.0	1.5	2.0	2.0	1.5
Social and Networking feature	C_{28}	1.5	1.0	1.5	1.0	0.0	2.0	1.5	2.0	1.0	2.5
Provision of adequate (synchronous and asynchronous) facility	C_{31}	2.0	2.0	2.0	2.5	3.0	0.0	2.5	2.5	2.0	3.0
Modernized technology equipped infrastructure	C_{32}	2.5	1.5	1.5	2.0	3.0	2.5	0.0	2.5	2.0	3.0
Availability of communication services (24 x 7)	C_{33}	3.0	2.0	1.0	2.0	3.0	2.5	2.5	0.0	2.0	2.5
Ease of use of learning management system	C_{34}	2.5	2.5	1.5	2.5	1.0	3.0	1.5	1.0	0.0	2.0
An adequate online support system (e-library, online orientation and experts online	C_{35}	3.0	2.5	1.0	2.5	3.0	3.0	2.5	2.5	2.5	0.0
Collaboration with international universities	C_{41}	2.5	1.5	1.0	2.5	1.5	1.5	2.0	1.5	1.0	1.0
Awarding an authoritative degree	C_{42}	3.0	2.0	2.0	3.0	2.0	3.0	1.5	2.0	1.5	2.0
Clearly defined policies and procedures	C_{43}	3.0	2.0	2.5	2.5	1.5	2.5	2.0	2.0	1.5	2.5
Reduction of carbon emission	C_{44}	0.5	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5
Improvement of retention rate	C_{45}	2.0	1.5	1.5	2.0	1.0	1.0	1.0	1.0	1.5	1.5
Lack of communication	C_{51}	1.0	1.5	1.0	1.0	1.0	1.0	1.0	1.5	1.0	1.0
Feeling of isolation	C_{52}	1.0	1.0	0.5	1.0	1.0	1.5	1.0	0.5	1.0	1.0
Effectiveness of interactions (student-student, student-teacher, student-content)	C_{53}	1.5	2.0	2.0	2.0	3.0	2.0	1.5	1.0	1.5	2.0
Prior knowledge of computers	C_{61}	1.5	1.5	1.0	1.0	2.0	3.0	2.5	1.5	2.5	2.5
Lack of sufficient funds and resources	C_{62}	2.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	1.0	3.0
Resistance to embrace change by stakeholders	C_{63}	2.5	1.0	1.0	1.0	1.5	1.0	2.5	1.5	1.0	2.0
Qualification and experience of tutor	C_{64}	3.0	3.5	3.5	2.5	2.0	3.0	2.5	2.0	3.0	2.0
A well explained content	C_{65}	3.5	3.5	2.5	1.5	3.0	2.0	1.5	1.5	1.5	3.5
Total C(sum)		76.5	65.5	62.5	70.5	68.0	74.5	67.0	59.0	57.5	69.5

Table 4.31 Average Value of opinions of DM1 and DM2

Average of DM1 and DM2		C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}
Problem based learning	C_{11}	2.5	3.0	3.0	3.0	3.0	1.5	1.0	3.0
Well defined course structure	C_{12}	3.0	3.0	3.5	3.0	1.5	0.5	0.5	3.0
Right blend of f2f and online learning activities	C_{13}	2.5	2.5	2.5	3.0	3.0	0.5	1.5	3.5
Appropriate use of delivery methods	C_{14}	3.0	3.0	2.5	2.5	2.5	0.5	3.0	3.5
Support of tutor	C_{15}	3.0	2.5	2.5	2.5	2.5	1.0	1.0	2.5
Prompt and continuous feedback	C_{16}	3.5	3.0	3.0	3.0	1.5	0.5	0.5	2.5
personalization of course content and course structure	C_{17}	3.5	3.0	2.5	1.5	2.0	0.5	0.5	2.0
Return on investments	C_{21}	3.0	1.5	2.0	1.0	1.0	0.5	0.5	1.0
Self-assessment	C_{22}	3.0	1.0	3.0	2.0	3.0	0.0	0.0	0.0
Strong leadership	C_{23}	3.0	2.5	3.0	2.0	1.5	1.5	0.5	2.0
Evaluation by international standards	C_{24}	3.0	2.5	3.0	2.0	1.5	1.0	0.5	2.0
Formal and informal kind of assessment	C_{25}	1.5	2.5	2.5	1.5	2.5	1.5	1.0	2.5
F2f discussion of student's performance	C_{26}	2.5	2.0	2.5	2.0	2.5	1.0	1.0	1.0
Sustainability feature	C_{27}	1.0	2.0	2.0	2.5	2.5	1.5	1.0	2.0
Social and Networking feature	C_{28}	2.5	2.0	1.5	2.5	1.5	1.0	2.5	2.5
Provision of adequate (synchronous and asynchronous) facility	C_{31}	3.0	2.5	2.5	2.5	3.0	3.0	3.0	2.5
Modernized technology equipped infrastructure	C_{32}	2.5	1.5	1.5	3.0	2.0	1.5	1.0	3.0
Availability of communication services (24 x 7)	C_{33}	3.0	1.5	2.0	2.5	1.0	2.5	2.5	2.5
Ease of use of learning management system	C_{34}	3.0	2.0	1.5	1.5	1.5	2.5	1.5	2.5
An adequate online support system (e-library, online orientation and experts online	C_{35}	3.0	2.0	1.0	2.5	1.5	1.5	1.0	2.0
Collaboration with international universities	C_{41}	0.0	2.5	1.5	2.5	1.0	1.0	1.0	1.5
Awarding an authoritative degree	C_{42}	1.5	0.0	3.0	1.0	1.0	1.0	1.0	1.5
Clearly defined policies and procedures	C_{43}	2.0	2.5	0.0	1.5	1.0	1.0	1.0	1.5
Reduction of carbon emission	C_{44}	0.5	0.5	0.5	0.0	1.0	0.5	0.5	0.5
Improvement of retention rate	C_{45}	1.5	1.0	1.0	1.0	0.0	1.0	1.5	2.0
Lack of communication	C_{51}	1.0	1.0	1.0	1.0	1.0	0.0	2.5	1.5
Feeling of isolation	C_{52}	1.0	1.0	0.5	0.5	1.0	0.5	0.0	0.0
Effectiveness of interactions (student-student, student-teacher, student-content)	C_{53}	1.5	1.5	2.0	1.5	2.5	1.5	1.5	0.0
Prior knowledge of computers	C_{61}	1.0	1.5	1.5	2.0	1.0	1.0	1.0	1.5
Lack of sufficient funds and resources	C_{62}	2.5	2.0	1.5	2.5	1.0	1.5	1.5	1.0
Resistance to embrace change by stakeholders	C_{63}	2.0	1.5	1.0	3.0	1.5	1.5	2.5	2.5
Qualification and experience of tutor	C_{64}	3.0	2.0	2.5	2.0	3.5	2.0	1.0	2.5
A well explained content	C_{65}	2.5	1.5	1.5	2.0	1.5	3.0	1.0	2.5
Total C (sum)		75.0	64.0	65.0	66.5	58.0	39.5	40.0	64.0

To be continued…

Table 4.32 Average values of opinions of DM1 and DM2

Average of DM1 and DM2		C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	Total R (sum)
Problem based learning	C_{11}	1.0	1.5	1.0	3.5	3.5	78.5
Well defined course structure	C_{12}	1.5	1.0	1.0	1.5	3.0	84.0
Right blend of f2f and online learning activities	C_{13}	2.5	2.5	1.0	2.5	3.0	85.5
Appropriate use of delivery methods	C_{14}	2.0	2.5	1.0	1.5	3.0	80.0
Support of tutor	C_{15}	1.5	1.0	3.0	1.0	3.0	81.0
Prompt and continuous feedback	C_{16}	1.5	1.5	2.0	2.0	2.5	66.0
personalization of course content and course structure	C_{17}	1.0	1.0	2.0	1.5	1.0	68.5
Return on investments	C_{21}	1.0	2.0	2.0	2.5	1.0	47.5
Self-assessment	C_{22}	3.5	1.0	1.5	1.0	1.0	73.0
Strong leadership	C_{23}	1.5	0.5	1.5	2.0	1.5	71.0
Evaluation by international standards	C_{24}	1.5	1.0	1.5	2.0	2.0	71.0
Formal and informal kind of assessment	C_{25}	1.5	1.5	2.0	2.0	1.5	65.5
F2f discussion of student’s performance	C_{26}	2.5	2.0	1.5	2.0	2.5	67.5
Sustainability feature	C_{27}	1.5	1.5	1.5	1.0	1.0	50.0
Social and Networking feature	C_{28}	2.5	1.5	1.5	1.5	2.0	53.5
Provision of adequate (synchronous and asynchronous) facility	C_{31}	2.5	2.0	2.5	3.0	2.5	82.5
Modernized technology equipped infrastructure	C_{32}	1.0	1.0	2.0	1.5	2.0	67.5
Availability of communication services (24 x 7)	C_{33}	1.5	1.5	2.0	1.0	2.0	65.5
Ease of use of learning management system	C_{34}	1.0	1.0	2.5	0.5	2.5	65.5
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.5	1.0	2.0	1.5	2.0	67.0
Collaboration with international universities	C_{41}	1.0	2.5	1.0	1.0	1.0	50.0
Awarding an authoritative degree	C_{42}	1.0	1.0	1.5	1.5	1.0	54.0
Clearly defined policies and procedures	C_{43}	1.0	1.0	1.5	1.0	1.0	64.5
Reduction of carbon emission	C_{44}	0.5	1.0	0.5	0.5	0.5	20.0
Improvement of retention rate	C_{45}	1.0	1.0	2.5	1.0	2.0	49.0
Lack of communication	C_{51}	1.0	1.0	2.5	1.0	1.0	39.5
Feeling of isolation	C_{52}	0.5	1.0	1.0	0.5	0.5	29.5
Effectiveness of interactions (student-student, student-teacher, student-content)	C_{53}	0.0	1.5	1.0	1.0	1.0	57.0
Prior knowledge of computers	C_{61}	0.0	0.0	1.5	1.5	2.5	58.0
Lack of sufficient funds and resources	C_{62}	1.0	0.0	1.0	1.5	1.0	58.0
Resistance to embrace change by stakeholders	C_{63}	1.0	1.0	0.0	0.0	1.0	51.0
Qualification and experience of tutor	C_{64}	3.0	1.5	1.0	0.0	3.0	83.5
A well explained content	C_{65}	0.5	1.0	0.0	2.0	0.0	73.0
Total C (sum)		44.5	42.0	50.0	47.5	58.0	

The next mathematical step in this method is to normalize the average matrix. The maximum value between max R (sum) and max C (sum) is calculated. The maximum value (out of the sums of rows and columns) comes out 85.5. The value 85.5 is divided by 1[(1/85.5) = 0.0117].The new calculated value is 0.0117.Now in the next mathematical step, all the 1089 elements of the Tables 4.29, 4.30, 4.31 and 4.32 are multiplied by value 0.0117. So, this step will lead to new matrix X and the next 4 tables, Table 4.33, Table 4.34, Table 4.35 and Table 4.36 show the values after being multiplied by 0.0117(the elements of matrix X).

Table 4.33 Matrix *X* (result of multiplication by 0.0117)

Matrix *X*		C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}
Problem based learning	C_{11}	0	0.0234	0.0351	0.0351	0.0234	0.0234	0.0351	0.041
Well defined course structure	C_{12}	0.0351	0	0.041	0.0468	0.0234	0.0351	0.0351	0.041
Right blend of f2f and online learning activities	C_{13}	0.0351	0.0351	0	0.041	0.0234	0.0351	0.0176	0.0234
Appropriate use of delivery methods	C_{14}	0.0351	0.0293	0.0351	0	0.0234	0.0351	0.0293	0.0176
Support of tutor	C_{15}	0.0351	0.0351	0.041	0.0351	0	0.0351	0.041	0.0351
Prompt and continuous feedback	C_{16}	0.0234	0.0234	0.0176	0.0176	0.0234	0	0.0234	0.0351
personalization of course content and course structure	C_{17}	0.0293	0.0293	0.0293	0.0351	0.0351	0.0293	0	0.0293
Return on investments	C_{21}	0.0293	0.0176	0.0176	0.0293	0.0117	0.0117	0.0059	0
Self-assessment	C_{22}	0	0.0351	0.0351	0.041	0.0351	0.0351	0.0468	0.041
Strong leadership	C_{23}	0.0293	0.0234	0.0293	0.0351	0.0351	0.0351	0.0293	0.0351
Evaluation by international standards	C_{24}	0.0351	0.0351	0.0293	0.0351	0.0293	0.0234	0.0234	0.0293
Formal and informal kind of assessment	C_{25}	0.0293	0.0351	0.0351	0.0351	0.0234	0.0351	0.0176	0.0293
F2f discussion of student’s performance	C_{26}	0.0176	0.0351	0.0293	0.0234	0.0234	0.0293	0.0293	0.0234
Sustainability feature	C_{27}	0.0176	0.0234	0.0176	0.0234	0.0117	0.0117	0.0234	0.0117
Social and Networking feature	C_{28}	0.0117	0.0117	0.0176	0.0176	0.0176	0.0176	0.0176	0.0117
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.0293	0.0293	0.041	0.0293	0.0351	0.0293	0.0234	0.0293
Modernized technology equipped infrastructure	C_{32}	0.0293	0.0234	0.0176	0.0351	0.0293	0.0234	0.0351	0.0293
Availability of communication services (24 x 7)	C_{33}	0.0117	0.0117	0.0351	0.0293	0.0176	0.0234	0.0176	0.0234
Ease of use of learning management system	C_{34}	0.0293	0.0293	0.0351	0.0351	0.0176	0.0234	0.0351	0.0234
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.0176	0.0234	0.0293	0.0351	0.0234	0.0293	0.0293	0.0176
Collaboration with international universities	C_{41}	0.0293	0.0176	0.0234	0.0176	0.0176	0.0176	0.0117	0.0117
Awarding an authoritative degree	C_{42}	0.0176	0.0176	0.0176	0.0176	0.0234	0.0234	0.0234	0.0234
Clearly defined policies and procedures	C_{43}	0.0351	0.0293	0.0293	0.0293	0.0351	0.0293	0.0234	0.0351
Reduction of carbon emission	C_{44}	0.0117	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
Improvement of retention rate	C_{45}	0.0234	0.0176	0.0117	0.0234	0.0117	0.0117	0.0176	0.0351
Lack of communication	C_{51}	0.0176	0.0117	0.0176	0.0117	0.0117	0.0117	0.0117	0.0117
Feeling of isolation	C_{52}	0.0117	0.0117	0.0117	0.0176	0.0117	0.0117	0.0059	0.0117
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.0293	0.0176	0.0176	0.0176	0.0234	0.0351	0.0234	0.0293
Prior knowledge of computers	C_{61}	0.0351	0.0351	0.0293	0.0293	0.0351	0.0176	0.0293	0.0176
Lack of sufficient funds and resources	C_{62}	0.0176	0.0176	0.0293	0.0293	0.0293	0.0176	0.0234	0.0234
Resistance to embrace change by stakeholders	C_{63}	0.0234	0.0176	0.0351	0.0293	0.0234	0.0176	0.0117	0.0117
Qualification and experience of tutor	C_{64}	0.0351	0.041	0.0351	0.041	0.0234	0.041	0.041	0.041
A well explained content	C_{65}	0.041	0.0351	0.041	0.0351	0.041	0.0176	0.0351	0.0351

To be continued….

Table 4.34 Matrix *X* (after multiplying by 0.0117)

Matrix *X*		C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}
Problem based learning	C_{11}	0.0351	0.0176	0.0351	0.041	0.0176	0.0293	0.0234	0.0351
Well defined course structure	C_{12}	0.0351	0.0293	0.041	0.0351	0.041	0.0468	0.041	0.0351
Right blend of f2f and online learning activities	C_{13}	0.0351	0.0176	0.0468	0.041	0.041	0.0351	0.0351	0.041
Appropriate use of delivery methods	C_{14}	0.0351	0.0176	0.0351	0.0351	0.0351	0.0293	0.0351	0.0351
Support of tutor	C_{15}	0.0234	0.0293	0.0293	0.0351	0.041	0.0351	0.0351	0.0351
Prompt and continuous feedback	C_{16}	0.0351	0.0293	0.041	0.0176	0.0351	0.041	0.0234	0.0176
personalization of course content and course structure	C_{17}	0.0176	0.0234	0.0351	0.0234	0.0351	0.041	0.0351	0.0293
Return on investments	C_{21}	0.0351	0.0176	0.0117	0.0059	0.0117	0.0117	0.0059	0.0293
Self-assessment	C_{22}	0	0	0.0351	0.0351	0.0351	0.0234	0.0351	0.0351
Strong leadership	C_{23}	0.0351	0	0.0293	0.0234	0.0293	0.0293	0.0234	0.0176
Evaluation by international standards	C_{24}	0.0351	0.0234	0	0.0293	0.0351	0.0293	0.0293	0.0293
Formal and informal kind of assessment	C_{25}	0.041	0.0059	0.0293	0	0.0176	0.0293	0.0234	0.0176
F2f discussion of student’s performance	C_{26}	0.0351	0.0176	0.0234	0.0176	0	0.0293	0.0293	0.0293
Sustainability feature	C_{27}	0.0117	0.0176	0.0176	0.0234	0.0176	0	0.0059	0.0234
Social and Networking feature	C_{28}	0.0351	0.0117	0.0176	0.0117	0.0176	0.0117	0	0.0234
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.0351	0.0293	0.0234	0.0234	0.0234	0.0293	0.0351	0
Modernized technology equipped infrastructure	C_{32}	0.0351	0.0176	0.0293	0.0176	0.0176	0.0234	0.0351	0.0293
Availability of communication services (24 x 7)	C_{33}	0.041	0.0176	0.0351	0.0234	0.0117	0.0234	0.0351	0.0293
Ease of use of learning management system	C_{34}	0.0351	0.0234	0.0293	0.0293	0.0176	0.0293	0.0117	0.0351
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.041	0.0234	0.0351	0.0293	0.0117	0.0293	0.0351	0.0351
Collaboration with international universities	C_{41}	0.0351	0.0117	0.0293	0.0176	0.0117	0.0293	0.0176	0.0176
Awarding an authoritative degree	C_{42}	0.0117	0.0117	0.0351	0.0234	0.0234	0.0351	0.0234	0.0351
Clearly defined policies and procedures	C_{43}	0.0351	0.0293	0.0351	0.0234	0.0293	0.0293	0.0176	0.0293
Reduction of carbon emission	C_{44}	0.0117	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0293
Improvement of retention rate	C_{45}	0.0351	0.0293	0.0234	0.0176	0.0176	0.0234	0.0117	0.0117
Lack of communication	C_{51}	0.0351	0.0117	0.0117	0.0176	0.0117	0.0117	0.0117	0.0117
Feeling of isolation	C_{52}	0.041	0.0059	0.0117	0.0117	0.0059	0.0117	0.0117	0.0176
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.0351	0.0293	0.0176	0.0234	0.0234	0.0234	0.0351	0.0234
Prior knowledge of computers	C_{61}	0.0234	0.0176	0.0176	0.0176	0.0117	0.0117	0.0234	0.0351
Lack of sufficient funds and resources	C_{62}	0.0176	0.0117	0.0234	0.0176	0.0176	0.0293	0.0293	0.0293
Resistance to embrace change by stakeholders	C_{63}	0.0234	0.0117	0.0293	0.0117	0.0117	0.0117	0.0176	0.0117
Qualification and experience of tutor	C_{64}	0.0176	0.0293	0.0351	0.041	0.041	0.0293	0.0234	0.0351
A well explained content	C_{65}	0.0468	0.0234	0.041	0.041	0.0293	0.0176	0.0351	0.0234

To be continued…..

Table 4.35 Matrix *X* (after multiplying by 0.0117)

Matrix *X*		C_{32}	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}
Problem based learning	C_{11}	0.0293	0.0293	0.0234	0.0293	0.0293	0.0351	0.0351	0.0351
Well defined course structure	C_{12}	0.0351	0.0234	0.0293	0.0293	0.0351	0.0351	0.041	0.0351
Right blend of f2f and online learning activities	C_{13}	0.041	0.041	0.0293	0.0293	0.0293	0.0293	0.0293	0.0351
Appropriate use of delivery methods	C_{14}	0.0293	0.0293	0.0293	0.0293	0.0351	0.0351	0.0293	0.0293
Support of tutor	C_{15}	0.0234	0.0293	0.0293	0.0293	0.0351	0.0293	0.0293	0.0293
Prompt and continuous feedback	C_{16}	0.0117	0.0117	0.0176	0.0117	0.041	0.0351	0.0351	0.0351
personalization of course content and course structure	C_{17}	0.0293	0.0117	0.0234	0.0234	0.041	0.0351	0.0293	0.0176
Return on investments	C_{21}	0.0293	0.0117	0.0117	0.0293	0.0351	0.0176	0.0234	0.0117
Self-assessment	C_{22}	0.041	0.0351	0.0351	0.041	0.0351	0.0117	0.0351	0.0234
Strong leadership	C_{23}	0.0351	0.0351	0.0176	0.0351	0.0351	0.0293	0.0351	0.0234
Evaluation by international standards	C_{24}	0.0293	0.0176	0.0293	0.0293	0.0351	0.0293	0.0351	0.0234
Formal and informal kind of assessment	C_{25}	0.0234	0.0176	0.0234	0.0176	0.0176	0.0293	0.0293	0.0176
F2f discussion of student's performance	C_{26}	0.0293	0.0293	0.0234	0.0234	0.0293	0.0234	0.0293	0.0234
Sustainability feature	C_{27}	0.0176	0.0234	0.0234	0.0176	0.0117	0.0234	0.0234	0.0293
Social and Networking feature	C_{28}	0.0176	0.0234	0.0117	0.0293	0.0293	0.0234	0.0176	0.0293
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.0293	0.0293	0.0234	0.0351	0.0351	0.0293	0.0293	0.0293
Modernized technology equipped infrastructure	C_{32}	0	0.0293	0.0234	0.0351	0.0293	0.0176	0.0176	0.0351
Availability of communication services (24 x 7)	C_{33}	0.0293	0	0.0234	0.0293	0.0351	0.0176	0.0234	0.0293
Ease of use of learning management system	C_{34}	0.0176	0.0117	0	0.0234	0.0351	0.0234	0.0176	0.0176
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.0293	0.0293	0.0293	0	0.0351	0.0234	0.0117	0.0293
Collaboration with international universities	C_{41}	0.0234	0.0176	0.0117	0.0117	0	0.0293	0.0176	0.0293
Awarding an authoritative degree	C_{42}	0.0176	0.0234	0.0176	0.0234	0.0176	0	0.0351	0.0117
Clearly defined policies and procedures	C_{43}	0.0234	0.0234	0.0176	0.0293	0.0234	0.0293	0	0.0176
Reduction of carbon emission	C_{44}	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0
Improvement of retention rate	C_{45}	0.0117	0.0117	0.0176	0.0176	0.0176	0.0117	0.0117	0.0117
Lack of communication	C_{51}	0.0117	0.0176	0.0117	0.0117	0.0117	0.0117	0.0117	0.0117
Feeling of isolation	C_{52}	0.0117	0.0059	0.0117	0.0117	0.0117	0.0117	0.0059	0.0059
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.0176	0.0117	0.0176	0.0234	0.0176	0.0176	0.0234	0.0176
Prior knowledge of computers	C_{61}	0.0293	0.0176	0.0293	0.0293	0.0117	0.0176	0.0176	0.0234
Lack of sufficient funds and resources	C_{62}	0.0293	0.0293	0.0117	0.0351	0.0293	0.0234	0.0176	0.0293
Resistance to embrace change by stakeholders	C_{63}	0.0293	0.0176	0.0117	0.0234	0.0234	0.0176	0.0117	0.0351
Qualification and experience of tutor	C_{64}	0.0293	0.0234	0.0351	0.0234	0.0351	0.0234	0.0293	0.0234
A well explained content	C_{65}	0.0176	0.0176	0.0176	0.041	0.0293	0.0176	0.0176	0.0234

To be continued…..

Table 4.36 Matrix *X* (after multiplying by 0.0117)

Multiplication by 0.0117		C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
Problem based learning	C_{11}	0.0351	0.0176	0.0117	0.0351	0.0117	0.0176	0.0117	0.041	0.041
Well defined course structure	C_{12}	0.0176	0.0059	0.0059	0.0351	0.0176	0.0117	0.0117	0.0176	0.0351
Right blend of f2f and online learning activities	C_{13}	0.0351	0.0059	0.0176	0.041	0.0293	0.0293	0.0117	0.0293	0.0351
Appropriate use of delivery methods	C_{14}	0.0293	0.0059	0.0351	0.041	0.0234	0.0293	0.0117	0.0176	0.0351
Support of tutor	C_{15}	0.0293	0.0117	0.0117	0.0293	0.0176	0.0117	0.0351	0.0117	0.0351
Prompt and continuous feedback	C_{16}	0.0176	0.0059	0.0059	0.0293	0.0176	0.0176	0.0234	0.0234	0.0293
personalization of course content and course structure	C_{17}	0.0234	0.0059	0.0059	0.0234	0.0117	0.0117	0.0234	0.0176	0.0117
Return on investments	C_{21}	0.0117	0.0059	0.0059	0.0117	0.0117	0.0234	0.0234	0.0293	0.0117
Self-assessment	C_{22}	0.0351	0	0	0	0.041	0.0117	0.0176	0.0117	0.0117
Strong leadership	C_{23}	0.0176	0.0176	0.0059	0.0234	0.0176	0.0059	0.0176	0.0234	0.0176
Evaluation by international standards	C_{24}	0.0176	0.0117	0.0059	0.0234	0.0176	0.0117	0.0176	0.0234	0.0234
Formal and informal kind of assessment	C_{25}	0.0293	0.0176	0.0117	0.0293	0.0176	0.0176	0.0234	0.0234	0.0176
F2f discussion of student's performance	C_{26}	0.0293	0.0117	0.0117	0.0117	0.0293	0.0234	0.0176	0.0234	0.0293
Sustainability feature	C_{27}	0.0293	0.0176	0.0117	0.0234	0.0176	0.0176	0.0176	0.0117	0.0117
Social and Networking feature	C_{28}	0.0176	0.0117	0.0293	0.0293	0.0293	0.0176	0.0176	0.0176	0.0234
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.0351	0.0351	0.0351	0.0293	0.0293	0.0234	0.0293	0.0351	0.0293
Modernized technology equipped infrastructure	C_{32}	0.0234	0.0176	0.0117	0.0351	0.0117	0.0117	0.0234	0.0176	0.0234
Availability of communication services (24 x 7)	C_{33}	0.0117	0.0293	0.0293	0.0293	0.0176	0.0176	0.0234	0.0117	0.0234
Ease of use of learning management system	C_{34}	0.0176	0.0293	0.0176	0.0293	0.0117	0.0117	0.0293	0.0059	0.0293
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.0176	0.0176	0.0117	0.0234	0.0059	0.0117	0.0234	0.0176	0.0234
Collaboration with international universities	C_{41}	0.0117	0.0117	0.0117	0.0176	0.0117	0.0293	0.0117	0.0117	0.0117
Awarding an authoritative degree	C_{42}	0.0117	0.0117	0.0117	0.0176	0.0117	0.0117	0.0176	0.0176	0.0117
Clearly defined policies and procedures	C_{43}	0.0117	0.0117	0.0117	0.0176	0.0117	0.0117	0.0176	0.0117	0.0117
Reduction of carbon emission	C_{44}	0.0117	0.0059	0.0059	0.0059	0.0059	0.0117	0.0059	0.0059	0.0059
Improvement of retention rate	C_{45}	0	0.0117	0.0176	0.0234	0.0117	0.0117	0.0293	0.0117	0.0234
Lack of communication	C_{51}	0.0117	0	0.0293	0.0176	0.0117	0.0117	0.0293	0.0117	0.0117
Feeling of isolation	C_{52}	0.0117	0.0059	0	0	0.0059	0.0117	0.0117	0.0059	0.0059
Effectiveness of interactions (student-student, student-teacher, student-content)	C_{53}	0.0293	0.0176	0.0176	0	0	0.0176	0.0117	0.0117	0.0117
Prior knowledge of computers	C_{61}	0.0117	0.0117	0.0117	0.0176	0	0	0.0176	0.0176	0.0293
Lack of sufficient funds and resources	C_{62}	0.0117	0.0176	0.0176	0.0117	0.0117	0	0.0117	0.0176	0.0117
Resistance to embrace change by stakeholders	C_{63}	0.0176	0.0176	0.0293	0.0293	0.0117	0.0117	0	0	0.0117
Qualification and experience of tutor	C_{64}	0.041	0.0234	0.0117	0.0293	0.0351	0.0176	0.0117	0	0.0351
A well explained content	C_{65}	0.0176	0.0351	0.0117	0.0293	0.0059	0.0117	0	0.0234	0

The next mathematical step is to find out the matrix ($I - X$). All elements of this Table X are subtracted from the identity matrix I_{33x33}.

$$\boldsymbol{I_{33x33}} = \begin{pmatrix} 1 & .. & 0 & .. & 0 \\ .. & .. & .. & .. & .. \\ 0 & .. & 1 & .. & 0 \\ .. & .. & .. & .. & .. \\ 0 & .. & 0 & .. & 1 \end{pmatrix}$$

This matrix I_{33x33} has 1089 elements. The main diagonal elements are taking value 1 and the rest of the elements will take value 0. All the values of Tables: Table 4.33, Table 4.34, Table 4.35, and Table 4.36 are subtracted from the identity matrix I with 1089 elements whose main diagonal elements are taking value 1 and the rest of the elements are taking value 0.The values of matrix (I $-X$) are shown in Tables: Table 4.37, Table 4.38, Table 4.39, and Table 4.40. These values are calculated by using the matrix subtraction method on Excel.

The next mathematical step will be to calculate the matrix inverse. The matrix inverse will be calculated will be calculated with the help of Excel. The values are shown in Tables: Table 4.41, Table 4.42, Table 4.43, and Table 4.44. These Tables: Table 4.37, Table 4.38, Table 4.39, Table 4.40, Table 4.41, Table 4.42, Table 4.43, and Table 4.44 are shown in the next few pages in continuation.

Table 4.37 Matrix ($I - X$)

Matrix ($I - X$)		C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}
Problem based learning	C_{11}	1	-0.0234	-0.0351	-0.0351	-0.0234	-0.0234	-0.0351	-0.04095
Well defined course structure	C_{12}	-0.0351	1	-0.04095	-0.0468	-0.0234	-0.0351	-0.0351	-0.04095
Right blend of f2f and online learning activities	C_{13}	-0.0351	-0.0351	1	-0.04095	-0.0234	-0.0351	-0.01755	-0.0234
Appropriate use of delivery methods	C_{14}	-0.0351	-0.02925	-0.0351	1	-0.0234	-0.0351	-0.02925	-0.01755
Support of tutor	C_{15}	-0.0351	-0.0351	-0.04095	-0.0351	1	-0.0351	-0.04095	-0.0351
Prompt and continuous feedback	C_{16}	-0.0234	-0.0234	-0.01755	-0.01755	-0.0234	1	-0.0234	-0.0351
personalization of course content and course structure	C_{17}	-0.02925	-0.02925	-0.02925	-0.0351	-0.0351	-0.02925	1	-0.02925
Return on investments	C_{21}	-0.02925	-0.01755	-0.01755	-0.02925	-0.0117	-0.0117	-0.00585	1
Self-assessment	C_{22}	0	-0.0351	-0.0351	-0.04095	-0.0351	-0.0351	-0.0468	-0.04095
Strong leadership	C_{23}	-0.02925	-0.0234	-0.02925	-0.0351	-0.0351	-0.0351	-0.02925	-0.0351
Evaluation by international standards	C_{24}	-0.0351	-0.0351	-0.02925	-0.0351	-0.02925	-0.0234	-0.0234	-0.02925
Formal and informal kind of assessment	C_{25}	-0.02925	-0.0351	-0.0351	-0.0351	-0.0234	-0.0351	-0.01755	-0.02925
F2f discussion of student’s performance	C_{26}	-0.01755	-0.0351	-0.02925	-0.0234	-0.0234	-0.02925	-0.02925	-0.0234
Sustainability feature	C_{27}	-0.01755	-0.0234	-0.01755	-0.0234	-0.0117	-0.0117	-0.0234	-0.0117
Social and Networking feature	C_{28}	-0.0117	-0.0117	-0.01755	-0.01755	-0.01755	-0.01755	-0.01755	-0.0117
Provision of adequate (synchronous and asynchronous) facility	C_{31}	-0.02925	-0.02925	-0.04095	-0.02925	-0.0351	-0.02925	-0.0234	-0.02925
Modernized technology equipped infrastructure	C_{32}	-0.02925	-0.0234	-0.01755	-0.0351	-0.02925	-0.0234	-0.0351	-0.02925
Availability of communication services (24 x 7)	C_{33}	-0.0117	-0.0117	-0.0351	-0.02925	-0.01755	-0.0234	-0.01755	-0.0234
Ease of use of learning management system	C_{34}	-0.02925	-0.02925	-0.0351	-0.0351	-0.01755	-0.0234	-0.0351	-0.0234
An adequate online support system (e-library, online orientation and experts online	C_{35}	-0.01755	-0.0234	-0.02925	-0.0351	-0.0234	-0.02925	-0.02925	-0.01755
Collaboration with international universities	C_{41}	-0.02925	-0.01755	-0.0234	-0.01755	-0.01755	-0.01755	-0.0117	-0.0117
Awarding an authoritative degree	C_{42}	-0.01755	-0.01755	-0.01755	-0.01755	-0.0234	-0.0234	-0.0234	-0.0234
Clearly defined policies and procedures	C_{43}	-0.0351	-0.02925	-0.02925	-0.02925	-0.0351	-0.02925	-0.0234	-0.0351
Reduction of carbon emission	C_{44}	-0.0117	-0.00585	-0.00585	-0.00585	-0.00585	-0.00585	-0.00585	-0.00585
Improvement of retention rate	C_{45}	-0.0234	-0.01755	-0.0117	-0.0234	-0.0117	-0.0117	-0.01755	-0.0351
Lack of communication	C_{51}	-0.01755	-0.0117	-0.01755	-0.0117	-0.0117	-0.0117	-0.0117	-0.0117
Feeling of isolation	C_{52}	-0.0117	-0.0117	-0.0117	-0.01755	-0.0117	-0.0117	-0.00585	-0.0117
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	-0.02925	-0.01755	-0.01755	-0.01755	-0.0234	-0.0351	-0.0234	-0.02925
Prior knowledge of computers	C_{61}	-0.0351	-0.0351	-0.02925	-0.02925	-0.0351	-0.01755	-0.02925	-0.01755
Lack of sufficient funds and resources	C_{62}	-0.01755	-0.01755	-0.02925	-0.02925	-0.02925	-0.01755	-0.0234	-0.0234
Resistance to embrace change by stakeholders	C_{63}	-0.0234	-0.01755	-0.0351	-0.02925	-0.0234	-0.01755	-0.0117	-0.0117
Qualification and experience of tutor	C_{64}	-0.0351	-0.04095	-0.0351	-0.04095	-0.0234	-0.04095	-0.04095	-0.04095
A well explained content	C_{65}	-0.04095	-0.0351	-0.04095	-0.0351	-0.04095	-0.01755	-0.0351	-0.0351

To be continued…

Table 4.38 Output of (*I*-*X*)

Matrix (I – X)		C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}
Problem based learning	C_{11}	-0.0351	-0.01755	-0.0351	-0.04095	-0.01755	-0.02925	-0.0234	-0.0351
Well defined course structure	C_{12}	-0.0351	-0.02925	-0.04095	-0.0351	-0.04095	-0.0468	-0.04095	-0.0351
Right blend of f2f and online learning activities	C_{13}	-0.0351	-0.01755	-0.0468	-0.04095	-0.04095	-0.0351	-0.0351	-0.04095
Appropriate use of delivery methods	C_{14}	-0.0351	-0.01755	-0.0351	-0.0351	-0.0351	-0.02925	-0.0351	-0.0351
Support of tutor	C_{15}	-0.0234	-0.02925	-0.02925	-0.0351	-0.04095	-0.0351	-0.0351	-0.0351
Prompt and continuous feedback	C_{16}	-0.0351	-0.02925	-0.04095	-0.01755	-0.0351	-0.04095	-0.0234	-0.01755
personalization of course content and course structure	C_{17}	-0.01755	-0.0234	-0.0351	-0.0234	-0.0351	-0.04095	-0.0351	-0.02925
Return on investments	C_{21}	-0.0351	-0.01755	-0.0117	-0.00585	-0.0117	-0.0117	-0.00585	-0.02925
Self-assessment	C_{22}	1	0	-0.0351	-0.0351	-0.0351	-0.0234	-0.0351	-0.0351
Strong leadership	C_{23}	-0.0351	1	-0.02925	-0.0234	-0.02925	-0.02925	-0.0234	-0.01755
Evaluation by international standards	C_{24}	-0.0351	-0.0234	1	-0.02925	-0.0351	-0.02925	-0.02925	-0.02925
Formal and informal kind of assessment	C_{25}	-0.04095	-0.00585	-0.02925	1	-0.01755	-0.02925	-0.0234	-0.01755
F2f discussion of student’s performance	C_{26}	-0.0351	-0.01755	-0.0234	-0.01755	1	-0.02925	-0.02925	-0.02925
Sustainability feature	C_{27}	-0.0117	-0.01755	-0.01755	-0.0234	-0.01755	1	-0.00585	-0.0234
Social and Networking feature	C_{28}	-0.0351	-0.0117	-0.01755	-0.0117	-0.01755	-0.0117	1	-0.0234
Provision of adequate (synchronous and asynchronous) facility	C_{31}	-0.0351	-0.02925	-0.0234	-0.0234	-0.0234	-0.02925	-0.0351	1
Modernized technology equipped infrastructure	C_{32}	-0.0351	-0.01755	-0.02925	-0.01755	-0.01755	-0.0234	-0.0351	-0.02925
Availability of communication services (24 x 7)	C_{33}	-0.04095	-0.01755	-0.0351	-0.0234	-0.0117	-0.0234	-0.0351	-0.02925
Ease of use of learning management system	C_{34}	-0.0351	-0.0234	-0.02925	-0.02925	-0.01755	-0.02925	-0.0117	-0.0351
An adequate online support system (e-library, online orientation and experts online	C_{35}	-0.04095	-0.0234	-0.0351	-0.02925	-0.0117	-0.02925	-0.0351	-0.0351
Collaboration with international universities	C_{41}	-0.0351	-0.0117	-0.02925	-0.01755	-0.0117	-0.02925	-0.01755	-0.01755
Awarding an authoritative degree	C_{42}	-0.0117	-0.0117	-0.0351	-0.0234	-0.0234	-0.0351	-0.0234	-0.0351
Clearly defined policies and procedures	C_{43}	-0.0351	-0.02925	-0.0351	-0.0234	-0.02925	-0.02925	-0.01755	-0.02925
Reduction of carbon emission	C_{44}	-0.0117	-0.00585	-0.00585	-0.00585	-0.00585	-0.00585	-0.00585	-0.02925
Improvement of retention rate	C_{45}	-0.0351	-0.02925	-0.0234	-0.01755	-0.01755	-0.0234	-0.0117	-0.0117
Lack of communication	C_{51}	-0.0351	-0.0117	-0.0117	-0.01755	-0.0117	-0.0117	-0.0117	-0.0117
Feeling of isolation	C_{52}	-0.04095	-0.00585	-0.0117	-0.0117	-0.00585	-0.0117	-0.0117	-0.01755
Effectiveness of interactions (student-student, student-teacher, student-content)	C_{53}	-0.0351	-0.02925	-0.01755	-0.0234	-0.0234	-0.0234	-0.0351	-0.0234
Prior knowledge of computers	C_{61}	-0.0234	-0.01755	-0.01755	-0.01755	-0.0117	-0.0117	-0.0234	-0.0351
Lack of sufficient funds and resources	C_{62}	-0.01755	-0.0117	-0.0234	-0.01755	-0.01755	-0.02925	-0.02925	-0.02925
Resistance to embrace change by stakeholders	C_{63}	-0.0234	-0.0117	-0.02925	-0.0117	-0.0117	-0.0117	-0.01755	-0.0117
Qualification and experience of tutor	C_{64}	-0.01755	-0.02925	-0.0351	-0.04095	-0.04095	-0.02925	-0.0234	-0.0351
A well explained content	C_{65}	-0.0468	-0.0234	-0.04095	-0.04095	-0.02925	-0.01755	-0.0351	-0.0234

To be continued….

Table 4.39 Output of (*I*-*X*)

Matrix (*I – X*)		C_{32}	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}
Problem based learning	C_{11}	-0.02925	-0.02925	-0.0234	-0.02925	-0.02925	-0.0351	-0.0351	-0.0351
Well defined course structure	C_{12}	-0.0351	-0.0234	-0.02925	-0.02925	-0.0351	-0.0351	-0.04095	-0.0351
Right blend of f2f and online learning activities	C_{13}	-0.04095	-0.04095	-0.02925	-0.02925	-0.02925	-0.02925	-0.02925	-0.0351
Appropriate use of delivery methods	C_{14}	-0.02925	-0.02925	-0.02925	-0.02925	-0.0351	-0.0351	-0.02925	-0.02925
Support of tutor	C_{15}	-0.0234	-0.02925	-0.02925	-0.02925	-0.0351	-0.02925	-0.02925	-0.02925
Prompt and continuous feedback	C_{16}	-0.0117	-0.0117	-0.01755	-0.0117	-0.04095	-0.0351	-0.0351	-0.0351
personalization of course content and course structure	C_{17}	-0.02925	-0.0117	-0.0234	-0.0234	-0.04095	-0.0351	-0.02925	-0.01755
Return on investments	C_{21}	-0.02925	-0.0117	-0.0117	-0.02925	-0.0351	-0.01755	-0.0234	-0.0117
Self-assessment	C_{22}	-0.04095	-0.0351	-0.0351	-0.04095	-0.0351	-0.0117	-0.0351	-0.0234
Strong leadership	C_{23}	-0.0351	-0.0351	-0.01755	-0.0351	-0.0351	-0.02925	-0.0351	-0.0234
Evaluation by international standards	C_{24}	-0.02925	-0.01755	-0.02925	-0.02925	-0.0351	-0.02925	-0.0351	-0.0234
Formal and informal kind of assessment	C_{25}	-0.0234	-0.01755	-0.0234	-0.01755	-0.01755	-0.02925	-0.02925	-0.01755
F2f discussion of student's performance	C_{26}	-0.02925	-0.02925	-0.0234	-0.0234	-0.02925	-0.0234	-0.02925	-0.0234
Sustainability feature	C_{27}	-0.01755	-0.0234	-0.0234	-0.01755	-0.0117	-0.0234	-0.0234	-0.02925
Social and Networking feature	C_{28}	-0.01755	-0.0234	-0.0117	-0.02925	-0.02925	-0.0234	-0.01755	-0.02925
Provision of adequate (synchronous and asynchronous) facility	C_{31}	-0.02925	-0.02925	-0.0234	-0.0351	-0.0351	-0.02925	-0.02925	-0.02925
Modernized technology equipped infrastructure	C_{32}	1	-0.02925	-0.0234	-0.0351	-0.02925	-0.01755	-0.01755	-0.0351
Availability of communication services (24 x 7)	C_{33}	-0.02925	1	-0.0234	-0.02925	-0.0351	-0.01755	-0.0234	-0.02925
Ease of use of learning management system	C_{34}	-0.01755	-0.0117	1	-0.0234	-0.0351	-0.0234	-0.01755	-0.01755
An adequate online support system (e-library, online orientation and experts online	C_{35}	-0.02925	-0.02925	-0.02925	1	-0.0351	-0.0234	-0.0117	-0.02925
Collaboration with international universities	C_{41}	-0.0234	-0.01755	-0.0117	-0.0117	1	-0.02925	-0.01755	-0.02925
Awarding an authoritative degree	C_{42}	-0.01755	-0.0234	-0.01755	-0.0234	-0.01755	1	-0.0351	-0.0117
Clearly defined policies and procedures	C_{43}	-0.0234	-0.0234	-0.01755	-0.02925	-0.0234	-0.02925	1	-0.01755
Reduction of carbon emission	C_{44}	-0.00585	-0.00585	-0.00585	-0.00585	-0.00585	-0.00585	-0.00585	1
Improvement of retention rate	C_{45}	-0.0117	-0.0117	-0.01755	-0.01755	-0.01755	-0.0117	-0.0117	-0.0117
Lack of communication	C_{51}	-0.0117	-0.01755	-0.0117	-0.0117	-0.0117	-0.0117	-0.0117	-0.0117
Feeling of isolation	C_{52}	-0.0117	-0.00585	-0.0117	-0.0117	-0.0117	-0.0117	-0.00585	-0.00585
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	-0.01755	-0.0117	-0.01755	-0.0234	-0.01755	-0.01755	-0.0234	-0.01755
Prior knowledge of computers	C_{61}	-0.02925	-0.01755	-0.02925	-0.02925	-0.0117	-0.01755	-0.01755	-0.0234
Lack of sufficient funds and resources	C_{62}	-0.02925	-0.02925	-0.0117	-0.0351	-0.02925	-0.0234	-0.01755	-0.02925
Resistance to embrace change by stakeholders	C_{63}	-0.02925	-0.01755	-0.0117	-0.0234	-0.0234	-0.01755	-0.0117	-0.0351
Qualification and experience of tutor	C_{64}	-0.02925	-0.0234	-0.0351	-0.0234	-0.0351	-0.0234	-0.02925	-0.0234
A well explained content	C_{65}	-0.01755	-0.01755	-0.01755	-0.04095	-0.02925	-0.01755	-0.01755	-0.0234

Table 4.40 Output of (*I*-*X*)

Matrix (*I* – *X*)		C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
Problem based learning	C_{11}	-0.0351	-0.01755	-0.0117	-0.0351	-0.0117	-0.01755	-0.0117	-0.04095	-0.04095
Well defined course structure	C_{12}	-0.01755	-0.00585	-0.00585	-0.0351	-0.01755	-0.0117	-0.0117	-0.01755	-0.0351
Right blend of f2f and online learning activities	C_{13}	-0.0351	-0.00585	-0.01755	-0.04095	-0.02925	-0.02925	-0.0117	-0.02925	-0.0351
Appropriate use of delivery methods	C_{14}	-0.02925	-0.00585	-0.0351	-0.04095	-0.0234	-0.02925	-0.0117	-0.01755	-0.0351
Support of tutor	C_{15}	-0.02925	-0.0117	-0.0117	-0.02925	-0.01755	-0.0117	-0.0351	-0.0117	-0.0351
Prompt and continuous feedback	C_{16}	-0.01755	-0.00585	-0.00585	-0.02925	-0.01755	-0.01755	-0.0234	-0.0234	-0.02925
personalization of course content and course structure	C_{17}	-0.0234	-0.00585	-0.00585	-0.0234	-0.0117	-0.0117	-0.0234	-0.01755	-0.0117
Return on investments	C_{21}	-0.0117	-0.00585	-0.00585	-0.0117	-0.0117	-0.0234	-0.0234	-0.02925	-0.0117
Self-assessment	C_{22}	-0.0351	0	0	0	-0.04095	-0.0117	-0.01755	-0.0117	-0.0117
Strong leadership	C_{23}	-0.01755	-0.01755	-0.00585	-0.0234	-0.01755	-0.00585	-0.01755	-0.0234	-0.01755
Evaluation by international standards	C_{24}	-0.01755	-0.0117	-0.00585	-0.0234	-0.01755	-0.0117	-0.01755	-0.0234	-0.0234
Formal and informal kind of assessment	C_{25}	-0.02925	-0.01755	-0.0117	-0.02925	-0.01755	-0.01755	-0.0234	-0.0234	-0.01755
F2f discussion of student's performance	C_{26}	-0.02925	-0.0117	-0.0117	-0.0117	-0.02925	-0.0234	-0.01755	-0.0234	-0.02925
Sustainability feature	C_{27}	-0.02925	-0.01755	-0.0117	-0.0234	-0.01755	-0.01755	-0.01755	-0.0117	-0.0117
Social and Networking feature	C_{28}	-0.01755	-0.0117	-0.02925	-0.02925	-0.02925	-0.01755	-0.01755	-0.01755	-0.0234
Provision of adequate (synchronous and asynchronous) facility	C_{31}	-0.0351	-0.0351	-0.0351	-0.02925	-0.02925	-0.0234	-0.02925	-0.0351	-0.02925
Modernized technology equipped infrastructure	C_{32}	-0.0234	-0.01755	-0.0117	-0.0351	-0.0117	-0.0117	-0.0234	-0.01755	-0.0234
Availability of communication services (24 x 7)	C_{33}	-0.0117	-0.02925	-0.02925	-0.02925	-0.01755	-0.01755	-0.0234	-0.0117	-0.0234
Ease of use of learning management system	C_{34}	-0.01755	-0.02925	-0.01755	-0.02925	-0.0117	-0.0117	-0.02925	-0.00585	-0.02925
An adequate online support system (e-library, online orientation and experts online	C_{35}	-0.01755	-0.01755	-0.0117	-0.0234	-0.00585	-0.0117	-0.0234	-0.01755	-0.0234
Collaboration with international universities	C_{41}	-0.0117	-0.0117	-0.0117	-0.01755	-0.0117	-0.02925	-0.0117	-0.0117	-0.0117
Awarding an authoritative degree	C_{42}	-0.0117	-0.0117	-0.0117	-0.01755	-0.0117	-0.0117	-0.01755	-0.01755	-0.0117
Clearly defined policies and procedures	C_{43}	-0.0117	-0.0117	-0.0117	-0.01755	-0.0117	-0.0117	-0.01755	-0.0117	-0.0117
Reduction of carbon emission	C_{44}	-0.0117	-0.00585	-0.00585	-0.00585	-0.00585	-0.0117	-0.00585	-0.00585	-0.00585
Improvement of retention rate	C_{45}	1	-0.0117	-0.01755	-0.0234	-0.0117	-0.0117	-0.02925	-0.0117	-0.0234
Lack of communication	C_{51}	-0.0117	1	-0.02925	-0.01755	-0.0117	-0.0117	-0.02925	-0.0117	-0.0117
Feeling of isolation	C_{52}	-0.0117	-0.00585	1	0	-0.00585	-0.0117	-0.0117	-0.00585	-0.00585
Effectiveness of interactions (student-student, student- teacher, student- content)	C_{53}	-0.02925	-0.01755	-0.01755	1	0	-0.01755	-0.0117	-0.0117	-0.0117
Prior knowledge of computers	C_{61}	-0.0117	-0.0117	-0.0117	-0.01755	1	0	-0.01755	-0.01755	0.97075
Lack of sufficient funds and resources	C_{62}	-0.0117	-0.01755	-0.01755	-0.0117	-0.0117	1	-0.0117	-0.01755	-0.0117
Resistance to embrace change by stakeholders	C_{63}	-0.01755	-0.01755	-0.02925	-0.02925	-0.0117	-0.0117	1	0	-0.0117
Qualification and experience of tutor	C_{64}	-0.04095	-0.0234	-0.0117	-0.02925	-0.0351	-0.01755	-0.0117	1	-0.0351
A well explained content	C_{65}	-0.01755	-0.0351	-0.0117	-0.02925	-0.00585	-0.0117	0	-0.0234	1

Table 4.41 Output of inverse of matrix (*I*-*X*)

Inverse of matrix (*I* – *X*)		C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}
Problem based learning	C_{11}	1.081924	0.1035632	0.1221896	0.1278956	0.0992333	0.1042677	0.1135924	0.1239564
Well defined course structure	C_{12}	0.1212284	1.0862067	0.1335546	0.1450185	0.1045623	0.1210018	0.1191524	0.1289722
Right blend of f2f and online learning activities	C_{13}	0.1208363	0.1200338	1.0943022	0.1396204	0.1043924	0.1210318	0.1028108	0.1126928
Appropriate use of delivery methods	C_{14}	0.114706	0.1084267	0.1216293	1.0931174	0.0990257	0.1149852	0.1077749	0.100863
Support of tutor	C_{15}	0.1176574	0.1162214	0.1300643	0.129898	1.0781058	0.1171388	0.1206113	0.1195655
Prompt and continuous feedback	C_{16}	0.0896731	0.088909	0.0893437	0.0937699	0.0855229	1.0663287	0.0880912	0.1027726
personalization of course content and course structure	C_{17}	0.1003307	0.0990704	0.1057072	0.1160216	0.1007326	0.0998527	1.0698791	0.1017448
Return on investments	C_{21}	0.078721	0.0670677	0.0723876	0.0869515	0.0592586	0.0623039	0.0559725	1.0520831
Self-assessment	C_{22}	0.0745315	0.1072207	0.1138908	0.1248355	0.1027332	0.1076922	0.116829	0.1146075
Strong leadership	C_{23}	0.1018481	0.0954706	0.1079981	0.1186343	0.1027928	0.1077502	0.1005712	0.1097646
Evaluation by international standards	C_{24}	0.1082609	0.107526	0.1091133	0.1195728	0.0979571	0.0973097	0.0959255	0.1049313
Formal and informal kind of assessment	C_{25}	0.0960696	0.1010097	0.1072389	0.112142	0.0860263	0.1018002	0.0837883	0.0985915
F2f discussion of student's performance	C_{26}	0.08547	0.101596	0.102624	0.1019001	0.0870784	0.0966236	0.0955882	0.0933009
Sustainability feature	C_{27}	0.0675587	0.0721017	0.0715886	0.0805279	0.0585213	0.0617484	0.0716502	0.0632349
Social and Networking feature	C_{28}	0.0627999	0.0625676	0.0732111	0.0766106	0.0660067	0.069071	0.0678854	0.0645371
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.1102666	0.1091073	0.1282006	0.1228457	0.1105469	0.1102884	0.1029267	0.1126114
Modernized technology equipped infrastructure	C_{32}	0.0973162	0.0907005	0.0923476	0.1134625	0.093149	0.0918478	0.1017353	0.0994341
Availability of communication services (24 x 7)	C_{33}	0.0765241	0.0758547	0.1044943	0.1033202	0.0785158	0.0878603	0.0805932	0.0891237
Ease of use of learning management system	C_{34}	0.0966927	0.0956556	0.1080619	0.1123826	0.0812591	0.0907902	0.1002594	0.092655
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.0868637	0.0917367	0.1044056	0.114455	0.0884228	0.0982851	0.0968545	0.0888936
Collaboration with international universities	C_{41}	0.0788496	0.0674626	0.0779801	0.0759833	0.0651269	0.0680262	0.0618142	0.0642077
Awarding an authoritative degree	C_{42}	0.073647	0.0729027	0.078342	0.0819031	0.0755597	0.0789544	0.0775229	0.0805248
Clearly defined policies and procedures	C_{43}	0.1018609	0.095783	0.102465	0.1071012	0.0978264	0.0967183	0.089677	0.1043519
Reduction of carbon emission	C_{44}	0.0322709	0.0264678	0.0287691	0.0299519	0.0256592	0.0266828	0.0263277	0.0275559
Improvement of retention rate	C_{45}	0.0728895	0.0667901	0.0662622	0.081032	0.0587709	0.0616125	0.0663692	0.0858982
Lack of communication	C_{51}	0.0561587	0.0506376	0.0604068	0.0575116	0.048817	0.0512644	0.0503027	0.0523639
Feeling of isolation	C_{52}	0.0419494	0.0425562	0.0456684	0.0534969	0.0409337	0.0427829	0.036901	0.0438173
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.0873533	0.0757622	0.081473	0.0856557	0.078636	0.0933818	0.081172	0.0903314
Prior knowledge of computers	C_{61}	-0.01918	-0.014315	-0.026284	-0.021997	-0.018466	-0.014844	-0.019264	-0.031689
Lack of sufficient funds and resources	C_{62}	0.0762023	0.0753504	0.0925031	0.0964513	0.083632	0.0762266	0.0804346	0.0829523
Resistance to embrace change by stakeholders	C_{63}	0.0737732	0.0671501	0.0888856	0.0869764	0.0704324	0.0681381	0.0612204	0.0636727
Qualification and experience of tutor	C_{64}	0.1197495	0.1236526	0.1258029	0.1372301	0.1021536	0.1243386	0.1223267	0.1272181
A well explained content	C_{65}	0.117244	0.1112831	0.1242888	0.1240545	0.1123674	0.0956381	0.1105656	0.1145682

Table 4.42 Output of inverse of matrix (*I*-*X*)

Inverse of matrix (*I – X*)		C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}
Problem based learning	C_{11}	0.1345839	0.07872785	0.1259887	0.11849	0.093951	0.114754	0.104836	0.124489
Well defined course structure	C_{12}	0.141361	0.093888	0.137742	0.117835	0.121505	0.137702	0.127211	0.130995
Right blend of f2f and online learning activities	C_{13}	0.1417445	0.08287584	0.1429899	0.123338	0.12094	0.126479	0.122144	0.136496
Appropriate use of delivery methods	C_{14}	0.1345651	0.07813269	0.1254854	0.112089	0.109813	0.114859	0.116118	0.124233
Support of tutor	C_{15}	0.1261741	0.09130513	0.1227859	0.114095	0.117691	0.122759	0.118002	0.12629
Prompt and continuous feedback	C_{16}	0.1154709	0.07857486	0.1144475	0.081172	0.09685	0.110443	0.089252	0.091438
personalization of course content and course structure	C_{17}	0.1051441	0.07696004	0.114676	0.091526	0.101375	0.116122	0.105767	0.107773
Return on investments	C_{21}	0.0959671	0.05489905	0.0689679	0.054942	0.058728	0.065177	0.057094	0.084753
Self-assessment	C_{22}	1.0907775	0.05630723	0.1171383	0.103785	0.103015	0.101814	0.10849	0.11656
Strong leadership	C_{23}	0.124706	1.05535678	0.1117555	0.093671	0.097597	0.106811	0.097057	0.099238
Evaluation by international standards	C_{24}	0.1253949	0.07859995	1.0838812	0.100137	0.103791	0.107516	0.103188	0.111137
Formal and informal kind of assessment	C_{25}	0.1229092	0.05701917	0.105149	1.065546	0.081401	0.100621	0.090995	0.092777
F2f discussion of student's performance	C_{26}	0.1180654	0.06879398	0.1001988	0.082909	1.064242	0.101338	0.09746	0.104718
Sustainability feature	C_{27}	0.0735701	0.05523523	0.0736585	0.070951	0.063887	1.05349	0.056413	0.078661
Social and Networking feature	C_{28}	0.0981668	0.05023805	0.0753833	0.061133	0.065228	0.06633	1.05256	0.080846
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.1356471	0.09005412	0.1152272	0.101776	0.099457	0.115196	0.116394	1.091154
Modernized technology equipped infrastructure	C_{32}	0.1197156	0.06935839	0.1062413	0.08386	0.081915	0.095976	0.104078	0.105361
Availability of communication services (24 x 7)	C_{33}	0.1210818	0.06562518	0.1072903	0.085399	0.072376	0.091439	0.099924	0.100968
Ease of use of learning management system	C_{34}	0.1183425	0.073685	0.1054017	0.094336	0.081176	0.100845	0.080371	0.109071
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.1261196	0.07500909	0.1131209	0.095977	0.077428	0.102617	0.104867	0.111401
Collaboration with international universities	C_{41}	0.0964045	0.04936285	0.085973	0.066575	0.05948	0.082755	0.068737	0.074486
Awarding an authoritative degree	C_{42}	0.0810098	0.05440074	0.097216	0.076714	0.075542	0.093981	0.079262	0.096348
Clearly defined policies and procedures	C_{43}	0.1178753	0.07954824	0.110983	0.088588	0.092644	0.101209	0.086042	0.1043
Reduction of carbon emission	C_{44}	0.0373597	0.02166402	0.0292233	0.025926	0.025273	0.028016	0.02702	0.051658
Improvement of retention rate	C_{45}	0.0963423	0.06585289	0.0791731	0.065495	0.064027	0.075581	0.0618	0.067044
Lack of communication	C_{51}	0.0834038	0.04066818	0.0563019	0.055355	0.048408	0.053214	0.051555	0.055516
Feeling of isolation	C_{52}	0.0781454	0.02863462	0.0469087	0.041786	0.035287	0.044618	0.043139	0.052003
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.1080723	0.0732458	0.0843308	0.079952	0.078784	0.086118	0.093739	0.088451
Prior knowledge of computers	C_{61}	-0.040429	-0.0156962	-0.038154	-0.03634	-0.030691	-0.02122	-0.025609	-0.004712
Lack of sufficient funds and resources	C_{62}	0.0904105	0.05598492	0.0895279	0.074128	0.072405	0.091351	0.088438	0.09475
Resistance to embrace change by stakeholders	C_{63}	0.0866901	0.04962738	0.0859939	0.060869	0.059273	0.065633	0.069193	0.068803
Qualification and experience of tutor	C_{64}	0.1223574	0.09291611	0.1295138	0.121017	0.11925	0.119122	0.107956	0.12802
A well explained content	C_{65}	0.1417821	0.08097157	0.1274083	0.11561	0.102198	0.100067	0.113141	0.109525

Table 4.43 Output of inverse of matrix (*I*-*X*)

Inverse of matrix (*I* – *X*)		C_{32}	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}
Problem based learning	C_{11}	0.109802	0.100188	0.093372	0.111179	0.119322	0.112147	0.114332	0.114167
Well defined course structure	C_{12}	0.121247	0.100189	0.103724	0.116943	0.13136	0.118361	0.126071	0.120562
Right blend of f2f and online learning activities	C_{13}	0.12669	0.11669	0.104112	0.116911	0.125515	0.112231	0.114535	0.120731
Appropriate use of delivery methods	C_{14}	0.109482	0.100139	0.098563	0.110694	0.124337	0.112214	0.10849	0.108927
Support of tutor	C_{15}	0.106529	0.102199	0.100249	0.11293	0.127327	0.109249	0.110906	0.111556
Prompt and continuous feedback	C_{16}	0.07866	0.070622	0.074679	0.079367	0.113863	0.098397	0.100471	0.100163
personalization of course content and course structure	C_{17}	0.100048	0.075302	0.084616	0.095178	0.119579	0.103713	0.099535	0.088693
Return on investments	C_{21}	0.079849	0.057198	0.055496	0.080158	0.090781	0.065794	0.072522	0.062321
Self-assessment	C_{22}	0.114123	0.0992	0.09854	0.114037	0.1173	0.083365	0.106614	0.096614
Strong leadership	C_{23}	0.107995	0.099495	0.081181	0.108529	0.116614	0.099531	0.106997	0.096149
Evaluation by international standards	C_{24}	0.103068	0.083403	0.092825	0.103798	0.117013	0.100271	0.107654	0.096697
Formal and informal kind of assessment	C_{25}	0.090849	0.077279	0.081797	0.085974	0.092883	0.093725	0.095758	0.084603
F2f discussion of student's performance	C_{26}	0.09737	0.089277	0.082312	0.092462	0.105098	0.088789	0.09599	0.091174
Sustainability feature	C_{27}	0.067448	0.067099	0.066242	0.067903	0.06721	0.071148	0.072211	0.078093
Social and Networking feature	C_{28}	0.069434	0.068817	0.056651	0.08103	0.086062	0.072276	0.067889	0.080022
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.110805	0.101399	0.09388	0.117088	0.125329	0.107133	0.108874	0.109993
Modernized technology equipped infrastructure	C_{32}	1.069273	0.089488	0.082653	0.104346	0.106184	0.083784	0.085258	0.103005
Availability of communication services (24 x 7)	C_{33}	0.09405	1.058029	0.079242	0.094854	0.106849	0.079748	0.086651	0.093526
Ease of use of learning management system	C_{34}	0.085697	0.071917	1.058747	0.091801	0.10989	0.088652	0.084577	0.08476
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.098477	0.090424	0.088959	1.071053	0.112541	0.090203	0.080713	0.098298
Collaboration with international universities	C_{41}	0.074207	0.062985	0.055885	0.063704	1.056674	0.07757	0.067967	0.079618
Awarding an authoritative degree	C_{42}	0.073539	0.072602	0.06593	0.079797	0.080175	1.054607	0.089749	0.067476
Clearly defined policies and procedures	C_{43}	0.091668	0.083728	0.076444	0.097738	0.099457	0.094498	1.068053	0.085089
Reduction of carbon emission	C_{44}	0.026941	0.024583	0.023932	0.027331	0.029272	0.025951	0.026468	1.020846
Improvement of retention rate	C_{45}	0.062471	0.056009	0.060591	0.068603	0.073465	0.059666	0.061201	0.061187
Lack of communication	C_{51}	0.051768	0.052459	0.045986	0.051978	0.055687	0.049297	0.050486	0.050953
Feeling of isolation	C_{52}	0.043318	0.03402	0.038922	0.04364	0.046704	0.041392	0.03687	0.037003
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.076705	0.064483	0.068377	0.083413	0.084223	0.074671	0.081811	0.076203
Prior knowledge of computers	C_{61}	-0.003724	-0.013217	-0.001447	-0.025387	-0.032985	-0.014045	-0.014907	-0.013704
Lack of sufficient funds and resources	C_{62}	0.087966	0.081451	0.062962	0.094137	0.094794	0.080058	0.07536	0.087884
Resistance to embrace change by stakeholders	C_{63}	0.079679	0.062692	0.055797	0.074604	0.079589	0.066226	0.061631	0.085357
Qualification and experience of tutor	C_{64}	0.113454	0.097552	0.107519	0.108452	0.128864	0.105252	0.112625	0.106804
well explained content	C_{65}	0.09569	0.086648	0.085074	0.118685	0.115824	0.092422	0.094612	0.099744

Table 4.44 Output of inverse of matrix (*I*-*X*)

Inverse of matrix (*I*-*X*)		C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
Problem based learning	C_{11}	0.105816	0.062772	0.058831	0.111362	0.067228	0.069899	0.072502	0.098068	0.0438638
Well defined course structure	C_{12}	0.093924	0.053974	0.056262	0.116868	0.077025	0.068191	0.076532	0.080035	0.0338575
Right blend of f2f and online learning activities	C_{13}	0.110723	0.054596	0.068146	0.122344	0.088337	0.08467	0.076909	0.090824	0.0233783
Appropriate use of delivery methods	C_{14}	0.099692	0.050992	0.08126	0.116189	0.078234	0.08083	0.072305	0.075282	0.0274817
Support of tutor	C_{15}	0.101604	0.057858	0.060373	0.108197	0.074131	0.06568	0.096614	0.071478	0.0336839
Prompt and continuous feedback	C_{16}	0.075594	0.04253	0.043755	0.090752	0.063003	0.060242	0.07245	0.07037	0.0235919
personalization of course content and course structure	C_{17}	0.085762	0.045265	0.047553	0.091297	0.060683	0.05812	0.076685	0.068475	0.0144114
Return on investments	C_{21}	0.056168	0.033946	0.035378	0.059363	0.04647	0.055599	0.060362	0.064582	0.0098733
Self-assessment	C_{22}	0.098262	0.040102	0.043435	0.071024	0.090981	0.059358	0.074224	0.063858	-0.012835
Strong leadership	C_{23}	0.081727	0.057424	0.048377	0.09278	0.067718	0.053489	0.072806	0.0753	0.0146642
Evaluation by international standards	C_{24}	0.082619	0.052449	0.048845	0.093424	0.068338	0.059545	0.072823	0.075983	0.0204723
Formal and informal kind of assessment	C_{25}	0.088227	0.053965	0.050951	0.092935	0.063978	0.06097	0.07374	0.071047	0.0134935
F2f discussion of student's performance	C_{26}	0.088257	0.049227	0.051387	0.076523	0.075898	0.066766	0.068938	0.071437	0.0135018
Sustainability feature	C_{27}	0.072407	0.045299	0.041356	0.070619	0.051137	0.049395	0.055397	0.047092	0.0048149
Social and Networking feature	C_{28}	0.062635	0.040099	0.059108	0.076701	0.064188	0.050574	0.056418	0.053631	0.0043637
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.106027	0.07938	0.082499	0.106174	0.084847	0.075687	0.090536	0.092193	0.0163703
Modernized technology equipped infrastructure	C_{32}	0.083691	0.055652	0.052319	0.099809	0.05878	0.056309	0.075018	0.066388	0.0250008
Availability of communication services (24 x 7)	C_{33}	0.068819	0.064616	0.067358	0.090041	0.06222	0.059634	0.072161	0.057782	0.0176825
Ease of use of learning management system	C_{34}	0.077173	0.066081	0.057065	0.093173	0.057891	0.055666	0.079425	0.054693	0.0301628
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.078814	0.056247	0.052761	0.089645	0.054247	0.056885	0.075413	0.066863	0.029983
Collaboration with international universities	C_{41}	0.056598	0.039625	0.041133	0.065309	0.046793	0.061449	0.049728	0.048103	0.0096453
Awarding an authoritative degree	C_{42}	0.060931	0.043103	0.044629	0.070762	0.050148	0.047891	0.059987	0.057506	0.0110712
Clearly defined policies and procedures	C_{43}	0.071539	0.048796	0.050674	0.081818	0.058478	0.055513	0.068598	0.060742	0.0135123
Reduction of carbon emission	C_{44}	0.030192	0.017838	0.018503	0.025593	0.020442	0.025102	0.021836	0.02111	0.0040316
Improvement of retention rate	C_{45}	1.044079	0.039212	0.046198	0.069949	0.04583	0.043785	0.066094	0.047311	0.0208124
Lack of communication	C_{51}	0.046619	1.021765	0.052056	0.054279	0.039017	0.037012	0.058491	0.03935	0.0072025
Feeling of isolation	C_{52}	0.03927	0.02269	1.018119	0.029351	0.028067	0.03167	0.035195	0.028008	0.0053087
Effectiveness of interactions (student-student, student-teacher, student- content)	C_{53}	0.080881	0.049991	0.05166	1.056103	0.041274	0.055626	0.056716	0.054467	0.0224335
Prior knowledge of computers	C_{61}	-0.018688	-0.029383	-0.007772	-0.023875	0.983398	-0.021319	0.005886	-0.01638	-0.967155
Lack of sufficient funds and resources	C_{62}	0.06358	0.050148	0.052431	0.068095	0.052327	1.038642	0.056462	0.059561	0.0116737
Resistance to embrace change by stakeholders	C_{63}	0.062099	0.044982	0.058778	0.077071	0.04615	0.044779	1.038307	0.036501	0.0105897
Qualification and experience of tutor	C_{64}	0.114067	0.069581	0.060851	0.109482	0.092078	0.072051	0.075782	1.061225	0.018004
A well explained content	C_{65}	0.086205	0.07655	0.056287	0.102254	0.059683	0.061949	0.058687	0.079166	1.0092519

The next mathematical step is to find the matrix $T = X* (I - X)^{(-1)}$ .The matrix T is computed by multiplying all the elements of matrix X by the elements matrix $(I - X)^{(-1)}$ .The values of Tables: Table 4.33, Table 4.34, Table 4.35 and Table 4.36 are multiplied by values in Tables: Table 4.41, Table 4.42, Table 4.43 and Table 4.44. The results of matrix T are displayed in next 4 tables, Table 4.45, Table 4.46, Table 4.47 and Table 4.48.

After getting matrix T, the next mathematical step is to find the threshold value .This value can be calculated by taking the average value of all the elements of the matrix T. This value is obtained by dividing total value of all the elements of this matrix T; 87.637779 by the total number of (33*33) elements. The threshold value is 0.08047.Only the cells with colored numbers are taken for further analysis. The other cell values are less than the threshold value, and hence, should be dropped as these values are insignificant for the purpose of establishing the cause effect relationships among criteria.

The last mathematical step of this technique is to calculate the columns of values of D and R as per Eq6 and Eq7. Afterwards, the columns of values of $D + R$ and $D - R$ are calculated. In general, when the value of $D - R$ is higher, then criterion belongs to the cause group. On the contrary, when the value of $D - R$ is lower, then the criterion belongs to the effect group. The impact relation map can be achieved by plotting the data set of points$\{(D + R, D - R)\}$.

The implication of the columns of $D + R$ and $D - R$ is immense. The column of $D + R$ signifies the level of importance, and the column of $D - R$ signifies the net effect the criterion has on the system. All the positive values of $D - R$ form the cause group, and all the negative values of $D - R$ form the effect group. The Table 4.49 represents all these values.

Table 4.45 Outcome of $T= X^* (I - X)^{(-1)}$

$T = X^* (I - X)^{(-1)}$		C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}
Problem based learning	C_{11}	0.081924	0.103563	0.122190	0.127896	0.099233	0.104268	0.113592
Well defined course structure	C_{12}	0.12123	0.086207	0.133555	0.145018	0.104562	0.121002	0.119152
Right blend of f2f and online learning activities	C_{13}	0.120836	0.120034	0.094302	0.139620	0.104392	0.121032	0.102811
Appropriate use of delivery methods	C_{14}	0.114706	0.108427	0.121629	0.093117	0.099026	0.114985	0.107775
Support of tutor	C_{15}	0.117657	0.116221	0.130064	0.129898	0.078106	0.117139	0.120611
Prompt and continuous feedback	C_{16}	0.089673	0.088909	0.089344	0.093770	0.085523	0.066329	0.088091
personalization of course content and course structure	C_{17}	0.100331	0.099070	0.105707	0.116022	0.100733	0.099853	0.069879
Return on investments	C_{21}	0.078721	0.067068	0.072388	0.086952	0.059259	0.062304	0.055972
Self-assessment	C_{22}	0.074532	0.107221	0.113891	0.124836	0.102733	0.107692	0.116829
Strong leadership	C_{23}	0.101848	0.095471	0.107998	0.118634	0.102793	0.107750	0.100571
Evaluation by international standards	C_{24}	0.108261	0.107526	0.109113	0.119573	0.097957	0.097310	0.095926
Formal and informal kind of assessment	C_{25}	0.096070	0.101010	0.107239	0.112142	0.086026	0.101800	0.083788
F2f discussion of student’s performance	C_{26}	0.085470	0.101596	0.102624	0.101900	0.087078	0.096624	0.095588
Sustainability feature	C_{27}	0.067559	0.072102	0.071589	0.080528	0.058521	0.061748	0.071650
Social and Networking feature	C_{28}	0.062800	0.062568	0.073211	0.076611	0.066007	0.069071	0.067885
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.110267	0.109107	0.128201	0.122846	0.110547	0.110288	0.102927
Modernized technology equipped infrastructure	C_{32}	0.097316	0.090700	0.092348	0.113463	0.093149	0.091848	0.101735
Availability of communication services (24 x 7)	C_{33}	0.076524	0.075855	0.104494	0.103320	0.078516	0.087860	0.080593
Ease of use of learning management system	C_{34}	0.096693	0.095656	0.108062	0.112383	0.081259	0.090790	0.100259
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.086864	0.091737	0.104406	0.114455	0.088423	0.098285	0.096855
Collaboration with international universities	C_{41}	0.078850	0.067463	0.077980	0.075983	0.065127	0.068026	0.061814
Awarding an authoritative degree	C_{42}	0.073647	0.072903	0.078342	0.081903	0.075560	0.078954	0.077523
Clearly defined policies and procedures	C_{43}	0.101861	0.095783	0.102465	0.107101	0.097826	0.096718	0.089677
Reduction of carbon emission	C_{44}	0.032271	0.026468	0.028769	0.029952	0.025659	0.026683	0.026328
Improvement of retention rate	C_{45}	0.072889	0.066790	0.066262	0.081032	0.058771	0.061612	0.066369
Lack of communication	C_{51}	0.056159	0.050638	0.060407	0.057512	0.048817	0.051264	0.050303
Feeling of isolation	C_{52}	0.041949	0.042556	0.045668	0.053497	0.040934	0.042783	0.036901
Effectiveness of interactions (student-student, student- teacher, student- content)	C_{53}	0.087353	0.075762	0.081473	0.085656	0.078636	0.093382	0.081172
Prior knowledge of computers	C_{61}	0.098064	0.096968	0.098005	0.102058	0.093902	0.080794	0.091302
Lack of sufficient funds and resources	C_{62}	0.076202	0.075350	0.092503	0.096451	0.083632	0.076227	0.080435
Resistance to embrace change by stakeholders	C_{63}	0.073773	0.067150	0.088886	0.086976	0.070432	0.068138	0.061220
Qualification and experience of tutor	C_{64}	0.119749	0.123653	0.125803	0.137230	0.102154	0.124339	0.122327
A well explained content	C_{65}	0.117244	0.111283	0.124289	0.124055	0.112367	0.095638	0.110566

To be continued…

Table 4.46 Outcome of $T=X^*(I-X)^{(-1)}$

$T = X^* (I - X)^{(-1)}$		C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}
Problem based learning	C_{11}	0.123956	0.134584	0.078728	0.125989	0.118490	0.093951	0.114754
Well defined course structure	C_{12}	0.128972	0.141361	0.093888	0.137742	0.117835	0.121505	0.137702
Right blend of f2f and online learning activities	C_{13}	0.112693	0.141745	0.082876	0.142990	0.123338	0.120940	0.126479
Appropriate use of delivery methods	C_{14}	0.100863	0.134565	0.078133	0.125485	0.112089	0.109813	0.114859
Support of tutor	C_{15}	0.119566	0.126174	0.091305	0.122786	0.114095	0.117691	0.122759
Prompt and continuous feedback	C_{16}	0.102773	0.115471	0.078575	0.114448	0.081172	0.096850	0.110443
personalization of course content and course structure	C_{17}	0.101745	0.105144	0.076960	0.114676	0.091526	0.101375	0.116122
Return on investments	C_{21}	0.052083	0.095967	0.054899	0.068968	0.054942	0.058728	0.065177
Self-assessment	C_{22}	0.114608	0.090777	0.056307	0.117138	0.103785	0.103015	0.101814
Strong leadership	C_{23}	0.109765	0.124706	0.055357	0.111756	0.093671	0.097597	0.106811
Evaluation by international standards	C_{24}	0.104931	0.125395	0.078600	0.083881	0.100137	0.103791	0.107516
Formal and informal kind of assessment	C_{25}	0.098591	0.122909	0.057019	0.105149	0.065546	0.081401	0.100621
F2f discussion of student's performance	C_{26}	0.093301	0.118065	0.068794	0.100199	0.082909	0.064242	0.101338
Sustainability feature	C_{27}	0.063235	0.073570	0.055235	0.073658	0.070951	0.063887	0.053490
Social and Networking feature	C_{28}	0.064537	0.098167	0.050238	0.075383	0.061133	0.065228	0.066330
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.112611	0.135647	0.090054	0.115227	0.101776	0.099457	0.115196
Modernized technology equipped infrastructure	C_{32}	0.099434	0.119716	0.069358	0.106241	0.083860	0.081915	0.095976
Availability of communication services (24 x 7)	C_{33}	0.089124	0.121082	0.065625	0.107290	0.085399	0.072376	0.091439
Ease of use of learning management system	C_{34}	0.092655	0.118342	0.073685	0.105402	0.094336	0.081176	0.100845
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.088894	0.126120	0.075009	0.113121	0.095977	0.077428	0.102617
Collaboration with international universities	C_{41}	0.064208	0.096404	0.049363	0.085973	0.066575	0.059480	0.082755
Awarding an authoritative degree	C_{42}	0.080525	0.081010	0.054401	0.097216	0.076714	0.075542	0.093981
Clearly defined policies and procedures	C_{43}	0.104352	0.117875	0.079548	0.110983	0.088588	0.092644	0.101209
Reduction of carbon emission	C_{44}	0.027556	0.037360	0.021664	0.029223	0.025926	0.025273	0.028016
Improvement of retention rate	C_{45}	0.085898	0.096342	0.065853	0.079173	0.065495	0.064027	0.075581
Lack of communication	C_{51}	0.052364	0.083404	0.040668	0.056302	0.055355	0.048408	0.053214
Feeling of isolation	C_{52}	0.043817	0.078145	0.028635	0.046909	0.041786	0.035287	0.044618
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.090331	0.108072	0.073246	0.084331	0.079952	0.078784	0.086118
Prior knowledge of computers	C_{61}	0.082880	0.101353	0.065275	0.089254	0.079270	0.071506	0.078847
Lack of sufficient funds and resources	C_{62}	0.082952	0.090411	0.055985	0.089528	0.074128	0.072405	0.091351
Resistance to embrace change by stakeholders	C_{63}	0.063673	0.086690	0.049627	0.085994	0.060869	0.059273	0.065633
Qualification and experience of tutor	C_{64}	0.127218	0.122357	0.092916	0.129514	0.121017	0.119250	0.119122
A well explained content	C_{65}	0.114568	0.141782	0.080972	0.127408	0.115610	0.102198	0.100067

To be continued……..

Table 4.47 Outcome of $T=X^* (I - X)^{(-1)}$

$T=X^* (I - X)^{(-1)}$		C28	C31	C32	C33	C34	C35	C41
Problem based learning	C11	0.104836	0.124489	0.109802	0.100188	0.093372	0.111179	0.119322
Well defined course structure	C12	0.127211	0.130995	0.121247	0.100189	0.103724	0.116943	0.131360
Right blend of f2f and online learning activities	C13	0.122144	0.136496	0.126690	0.116690	0.104112	0.116911	0.125515
Appropriate use of delivery methods	C14	0.116118	0.124233	0.109482	0.100139	0.098563	0.110694	0.124337
Support of tutor	C15	0.118002	0.126290	0.106529	0.102199	0.100249	0.112930	0.127327
Prompt and continuous feedback	C16	0.089252	0.091438	0.078660	0.070622	0.074679	0.079367	0.113863
personalization of course content and course structure	C17	0.105767	0.107773	0.100048	0.075302	0.084616	0.095178	0.119579
Return on investments	C21	0.057094	0.084753	0.079849	0.057198	0.055496	0.080158	0.090781
Self-assessment	C22	0.108490	0.116560	0.114123	0.099200	0.098540	0.114037	0.117300
Strong leadership	C23	0.097057	0.099238	0.107995	0.099495	0.081181	0.108529	0.116614
Evaluation by international standards	C24	0.103188	0.111137	0.103068	0.083403	0.092825	0.103798	0.117013
Formal and informal kind of assessment	C25	0.090995	0.092777	0.090849	0.077279	0.081797	0.085974	0.092883
F2f discussion of student's performance	C26	0.097460	0.104718	0.097370	0.089277	0.082312	0.092462	0.105098
Sustainability feature	C27	0.056413	0.078661	0.067448	0.067099	0.066242	0.067903	0.067210
Social and Networking feature	C28	0.052560	0.080846	0.069434	0.068817	0.056651	0.081030	0.086062
Provision of adequate (synchronous and asynchronous) facility	C31	0.116394	0.091154	0.110805	0.101399	0.093880	0.117088	0.125329
Modernized technology equipped infrastructure	C32	0.104078	0.105361	0.069273	0.089488	0.082653	0.104346	0.106184
Availability of communication services (24 x 7)	C33	0.099924	0.100968	0.094050	0.058029	0.079242	0.094854	0.106849
Ease of use of learning management system	C34	0.080371	0.109071	0.085697	0.071917	0.058747	0.091801	0.109890
An adequate online support system (e-library, online orientation and experts online	C35	0.104867	0.111401	0.098477	0.090424	0.088959	0.071053	0.112541
Collaboration with international universities	C41	0.068737	0.074486	0.074207	0.062985	0.055885	0.063704	0.056674
Awarding an authoritative degree	C42	0.079262	0.096348	0.073539	0.072602	0.065930	0.079797	0.080175
Clearly defined policies and procedures	C43	0.086042	0.104300	0.091668	0.083728	0.076444	0.097738	0.099457
Reduction of carbon emission	C44	0.027020	0.051658	0.026941	0.024583	0.023932	0.027331	0.029272
Improvement of retention rate	C45	0.061800	0.067044	0.062471	0.056009	0.060591	0.068603	0.073465
Lack of communication	C51	0.051555	0.055516	0.051768	0.052459	0.045986	0.051978	0.055687
Feeling of isolation	C52	0.043139	0.052003	0.043318	0.034020	0.038922	0.043640	0.046704
Effectiveness of interactions (student-student, student- teacher, student-content)	C53	0.093739	0.088451	0.076705	0.064483	0.068377	0.083413	0.084223
Prior knowledge of computers	C61	0.087532	0.104813	0.091967	0.073431	0.083627	0.093298	0.082839
Lack of sufficient funds and resources	C62	0.088438	0.094750	0.087966	0.081451	0.062962	0.094137	0.094794
Resistance to embrace change by stakeholders	C63	0.069193	0.068803	0.079679	0.062692	0.055797	0.074604	0.079589
Qualification and experience of tutor	C64	0.107956	0.128020	0.113454	0.097552	0.107519	0.108452	0.128864
A well explained content	C65	0.113141	0.109525	0.095690	0.086648	0.085074	0.118685	0.115824

Table 4.48 Outcome of $T=X^{*} (I-X)^{(-1)}$

$T = X^{*} (I-X)^{(-1)}$		C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}
Problem based learning	C_{11}	0.112147	0.114332	0.114167	0.105816	0.062772	0.058831	0.111362
Well defined course structure	C_{12}	0.118361	0.126071	0.120562	0.093924	0.053974	0.056262	0.116868
Right blend of f2f and online learning activities	C_{13}	0.112231	0.114535	0.120731	0.110723	0.054596	0.068146	0.122344
Appropriate use of delivery methods	C_{14}	0.112214	0.108490	0.108927	0.099692	0.050992	0.081260	0.116189
Support of tutor	C_{15}	0.109249	0.110906	0.111556	0.101604	0.057858	0.060373	0.108197
Prompt and continuous feedback	C_{16}	0.098397	0.100471	0.100163	0.075594	0.042530	0.043755	0.090752
personalization of course content and course structure	C_{17}	0.103713	0.099535	0.088693	0.085762	0.045265	0.047553	0.091297
Return on investments	C_{21}	0.065794	0.072522	0.062321	0.056168	0.033946	0.035378	0.059363
Self-assessment	C_{22}	0.083365	0.106614	0.096614	0.098262	0.040102	0.043435	0.071024
Strong leadership	C_{23}	0.099531	0.106997	0.096149	0.081727	0.057424	0.048377	0.092780
Evaluation by international standards	C_{24}	0.100271	0.107654	0.096697	0.082619	0.052449	0.048845	0.093424
Formal and informal kind of assessment	C_{25}	0.093725	0.095758	0.084603	0.088227	0.053965	0.050951	0.092935
F2f discussion of student's performance	C_{26}	0.088789	0.095990	0.091174	0.088257	0.049227	0.051387	0.076523
Sustainability feature	C_{27}	0.071148	0.072211	0.078093	0.072407	0.045299	0.041356	0.070619
Social and Networking feature	C_{28}	0.072276	0.067889	0.080022	0.062635	0.040099	0.059108	0.076701
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.107133	0.108874	0.109993	0.106027	0.079380	0.082499	0.106174
Modernized technology equipped infrastructure	C_{32}	0.083784	0.085258	0.103005	0.083691	0.055652	0.052319	0.099809
Availability of communication services (24 x 7)	C_{33}	0.079748	0.086651	0.093526	0.068819	0.064616	0.067358	0.090041
Ease of use of learning management system	C_{34}	0.088652	0.084577	0.084760	0.077173	0.066081	0.057065	0.093173
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.090203	0.080713	0.098298	0.078814	0.056247	0.052761	0.089645
Collaboration with international universities	C_{41}	0.077570	0.067967	0.079618	0.056598	0.039625	0.041133	0.065309
Awarding an authoritative degree	C_{42}	0.054607	0.089749	0.067476	0.060931	0.043103	0.044629	0.070762
Clearly defined policies and procedures	C_{43}	0.094498	0.068053	0.085089	0.071539	0.048796	0.050674	0.081818
Reduction of carbon emission	C_{44}	0.025951	0.026468	0.020846	0.030192	0.017838	0.018503	0.025593
Improvement of retention rate	C_{45}	0.059666	0.061201	0.061187	0.044079	0.039212	0.046198	0.069949
Lack of communication	C_{51}	0.049297	0.050486	0.050953	0.046619	0.021765	0.052056	0.054279
Feeling of isolation	C_{52}	0.041392	0.036870	0.037003	0.039270	0.022690	0.018119	0.029351
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.074671	0.081811	0.076203	0.080881	0.049991	0.051660	0.056103
Prior knowledge of computers	C_{61}	0.078376	0.079705	0.086039	0.067517	0.047167	0.048515	0.078379
Lack of sufficient funds and resources	C_{62}	0.080058	0.075360	0.087884	0.063580	0.050148	0.052431	0.068095
Resistance to embrace change by stakeholders	C_{63}	0.066226	0.061631	0.085357	0.062099	0.044982	0.058778	0.077071
Qualification and experience of tutor	C_{64}	0.105252	0.112625	0.106804	0.114067	0.069581	0.060851	0.109482
A well explained content	C_{65}	0.092422	0.094612	0.099744	0.086205	0.076550	0.056287	0.102254

To be continued….

Table 4.49 Outcome of $T=X^*(I-X)^{(-1)}$

$T=X^*(I-X)^{(-1)}$		C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
Problem based learning	C_{11}	0.067228	0.069899	0.072502	0.098068	0.043864
Well defined course structure	C_{12}	0.077025	0.068191	0.076532	0.080035	0.033857
Right blend of f2f and online learning activities	C_{13}	0.088337	0.084670	0.076909	0.090824	0.023378
Appropriate use of delivery methods	C_{14}	0.078234	0.080830	0.072305	0.075282	0.027482
Support of tutor	C_{15}	0.074131	0.065680	0.096614	0.071478	0.033684
Prompt and continuous feedback	C_{16}	0.063003	0.060242	0.072450	0.070370	0.023592
personalization of course content and course structure	C_{17}	0.060683	0.058120	0.076685	0.068475	0.014411
Return on investments	C_{21}	0.046470	0.055599	0.060362	0.064582	0.009873
Self-assessment	C_{22}	0.090981	0.059358	0.074224	0.063858	-0.012835
Strong leadership	C_{23}	0.067718	0.053489	0.072806	0.075300	0.014664
Evaluation by international standards	C_{24}	0.068338	0.059545	0.072823	0.075983	0.020472
Formal and informal kind of assessment	C_{25}	0.063978	0.060970	0.073740	0.071047	0.013493
F2f discussion of student's performance	C_{26}	0.075898	0.066766	0.068938	0.071437	0.013502
Sustainability feature	C_{27}	0.051137	0.049395	0.055397	0.047092	0.004815
Social and Networking feature	C_{28}	0.064188	0.050574	0.056418	0.053631	0.004364
Provision of adequate (synchronous and asynchronous) facility	C_{31}	0.084847	0.075687	0.090536	0.092193	0.016370
Modernized technology equipped infrastructure	C_{32}	0.058780	0.056309	0.075018	0.066388	0.025001
Availability of communication services (24 x 7)	C_{33}	0.062220	0.059634	0.072161	0.057782	0.017683
Ease of use of learning management system	C_{34}	0.057891	0.055666	0.079425	0.054693	0.030163
An adequate online support system (e-library, online orientation and experts online	C_{35}	0.054247	0.056885	0.075413	0.066863	0.029983
Collaboration with international universities	C_{41}	0.046793	0.061449	0.049728	0.048103	0.009645
Awarding an authoritative degree	C_{42}	0.050148	0.047891	0.059987	0.057506	0.011071
Clearly defined policies and procedures	C_{43}	0.058478	0.055513	0.068598	0.060742	0.013512
Reduction of carbon emission	C_{44}	0.020442	0.025102	0.021836	0.021110	0.004032
Improvement of retention rate	C_{45}	0.045830	0.043785	0.066094	0.047311	0.020812
Lack of communication	C_{51}	0.039017	0.037012	0.058491	0.039350	0.007202
Feeling of isolation	C_{52}	0.028067	0.031670	0.035195	0.028008	0.005309
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	0.041274	0.055626	0.056716	0.054467	0.022434
Prior knowledge of computers	C_{61}	0.043080	0.040629	0.064573	0.062786	0.042096
Lack of sufficient funds and resources	C_{62}	0.052327	0.038642	0.056462	0.059561	0.011674
Resistance to embrace change by stakeholders	C_{63}	0.046150	0.044779	0.038307	0.036501	0.010590
Qualification and experience of tutor	C_{64}	0.092078	0.072051	0.075782	0.061225	0.018004
A well explained content	C_{65}	0.059683	0.061949	0.058687	0.079166	0.009252

As per Eq 6 and Eq 7, the calculation are done and shown in the next Table 4.50.

Table 4.50 Calculation of *(D + R)* and *(D – R)*

		D	R	D + R	D – R
Problem based learning	C_{11}	2.883471	2.053415	4.936886	0.830056
Well defined course structure	C_{12}	3.117183	2.050141	5.167324	1.067043
Right blend of f2f and online learning activities	C_{13}	3.347039	2.588589	5.935629	0.758450
Appropriate use of delivery methods	C_{14}	2.948509	3.058834	6.007342	-0.110325
Support of tutor	C_{15}	2.977619	1.933316	4.910935	1.044303
Prompt and continuous feedback	C_{16}	1.840801	2.159396	4.000197	-0.318595
personalization of course content and course structure	C_{17}	2.334262	2.122147	4.456409	0.212115
Return on investments	C_{21}	0.358452	2.563205	2.921657	-2.204754
Self-assessment	C_{22}	2.548426	3.421639	5.970065	-0.873212
Strong leadership	C_{23}	2.566662	0.532011	3.098673	2.034652
Evaluation by international standards	C_{24}	2.556412	2.849720	5.406133	-0.293308
Formal and informal kind of assessment	C_{25}	2.187269	1.925611	4.112880	0.261658
F2f discussion of student's performance	C_{26}	2.199600	1.724568	3.924168	0.475032
Sustainability feature	C_{27}	0.080528	2.541893	2.622421	-2.461365
Social and Networking feature	C_{28}	0.346105	2.282631	2.628736	-1.936527
Provision of adequate (synchronous and asynchronous) facility	C_{31}	3.208477	2.775902	5.984379	0.432575
Modernized technology equipped infrastructure	C_{32}	2.315357	2.056978	4.372335	0.258379
Availability of communication services (24 x 7)	C_{33}	1.637465	1.521468	3.158934	0.115997
Ease of use of learning management system	C_{34}	2.025477	1.563001	3.588478	0.462476
An adequate online support system (e-library, online orientation and experts online	C_{35}	2.173279	2.253478	4.426757	-0.080199
Collaboration with international universities	C_{41}	0.265132	2.753845	3.018978	-2.488713
Awarding an authoritative degree	C_{42}	0.620732	1.893937	2.514668	-1.273205
Clearly defined policies and procedures	C_{43}	2.131420	2.112222	4.243642	0.019198
Reduction of carbon emission	C_{44}	0.000000	2.270533	2.270533	-2.270533
Improvement of retention rate	C_{45}	0.263273	1.507485	1.770757	-1.244212
Lack of communication	C_{51}	0.083404	0.000000	0.083404	0.083404
Feeling of isolation	C_{52}	0.000000	0.163759	0.163759	-0.163759
Effectiveness of interactions (student-student, student- teacher, student-content)	C_{53}	1.310406	1.808543	3.118949	-0.498137
Prior knowledge of computers	C_{61}	1.564692	0.356243	1.920935	1.208449
Lack of sufficient funds and resources	C_{62}	1.256248	0.165500	1.421748	1.090748
Resistance to embrace change by stakeholders	C_{63}	0.433903	0.187150	0.621053	0.246753
Qualification and experience of tutor	C_{64}	3.118773	0.281085	3.399859	2.837688
A well explained content	C_{65}	2.777869	0.000000	2.777869	2.777869

The elements of the cause group are written in the following Table 4.51. They are arranged in the descending order of their influence.

Table 4.51 Cause group

Positive values of *(D – R)* form Cause group	**Level of Influence from highest to lowest value**
2.837688225	Qualification and experience of tutor
2.777869036	A well explained content
2.034651596	Strong leadership
1.208448916	Prior knowledge of computers
1.090748262	Lack of sufficient funds and resources
1.067042639	Well defined course structure
1.044303053	Support of tutor
0.830055643	Problem based learning
0.758450005	Right blend of f2f and online learning activities
0.475032039	F2f discussion of student's performance
0.462476284	Ease of use of learning management system
0.432574984	Provision of adequate (synchronous and asynchronous) facility
0.261657674	Formal and informal kind of assessment
0.258379153	Modernized technology equipped infrastructure
0.246752904	Resistance to embrace change by stakeholders
0.21211506	Personalization of course content and course structure
0.115996624	Provision of communication services (24 x 7)
0.083403822	Lack of communication
0.019197819	Clearly defined policies and procedures

After analyzing the cause group, the researcher finds that the criterion C_{64} "Qualification and experience of tutor" influences the other criteria in the most significant way. This criterion is the master influencer or the master dispatcher. The educational institutions have to be very careful regarding this parameter in developing the course structure in the blended learning environment. An effective and excellent quality education can be delivered by carefully implementing all the above criteria in the cause group in Table 4.52.

Although the quality of all the criteria of the BLE is important, it is still recommended to enhance and develop in a continuous manner the quality of the cause criteria with the first priority under the limitations of rising costs, limited budgets, limited time, and limited costs. The adoption of this technique can bring excellence in the quality of the BLE with less effort.

The following Table 4.52 shows the effect group. The values of $D - R$ are written in descending order (highest value to the lowest value).

Table 4.52 Effect Group

Negative values of (*D – R)* form Effect group	**Values are written from highest to lowest way**
-0.080198511	An adequate online support system
-0.110324804	Appropriate use of delivery methods
-0.163759146	Feeling of isolation
-0.293307869	Evaluation by international standards
-0.318595298	Prompt and continuous feedback
-0.498136997	Effectiveness of interactions (student-student, student-teacher, student-content)
-0.873212434	Self-assessment
-1.244212169	Improvement of retention rate
-1.273204735	Awarding an authoritative degree
-1.936526623	Social and Networking feature
-2.204753507	Positive return on investments
-2.270533498	Reduction of carbon emission
-2.461364976	Sustainability feature
-2.488713171	Collaboration with international universities

After analyzing the effect group, it is very clear that the criterion "collaboration with international university" is influenced by all the remaining criteria strongly. This criterion is the master receiver. Similarly, the criterion "sustainability feature" and criterion "reduction of carbon emission" are receiving intense influence.

4.4.2.1 Practical Implication of DEMATEL on Criteria

The practical utility of this technique is that there is no need to take any separate step in improving the quality of the effect group criteria since these criteria are influenced by the cause group criteria. By enhancing and controlling the quality for all these cause group criteria will improve the quality feature of all those criteria which are part of effect group. Hence, an effort to optimize the COQ is made without incurring any extra cost and resources.

After looking at the values of $D + R$, the most related component can be found by looking at the highest value in the column $D + R$. The criterion C_{14} "appropriate use of delivery methods" is the most related criterion. The values of $(D + R)$ column are plotted on the x axis, and values of $(D - R)$ are plotted on y axis. The following Figure 4.7 depicts this information.

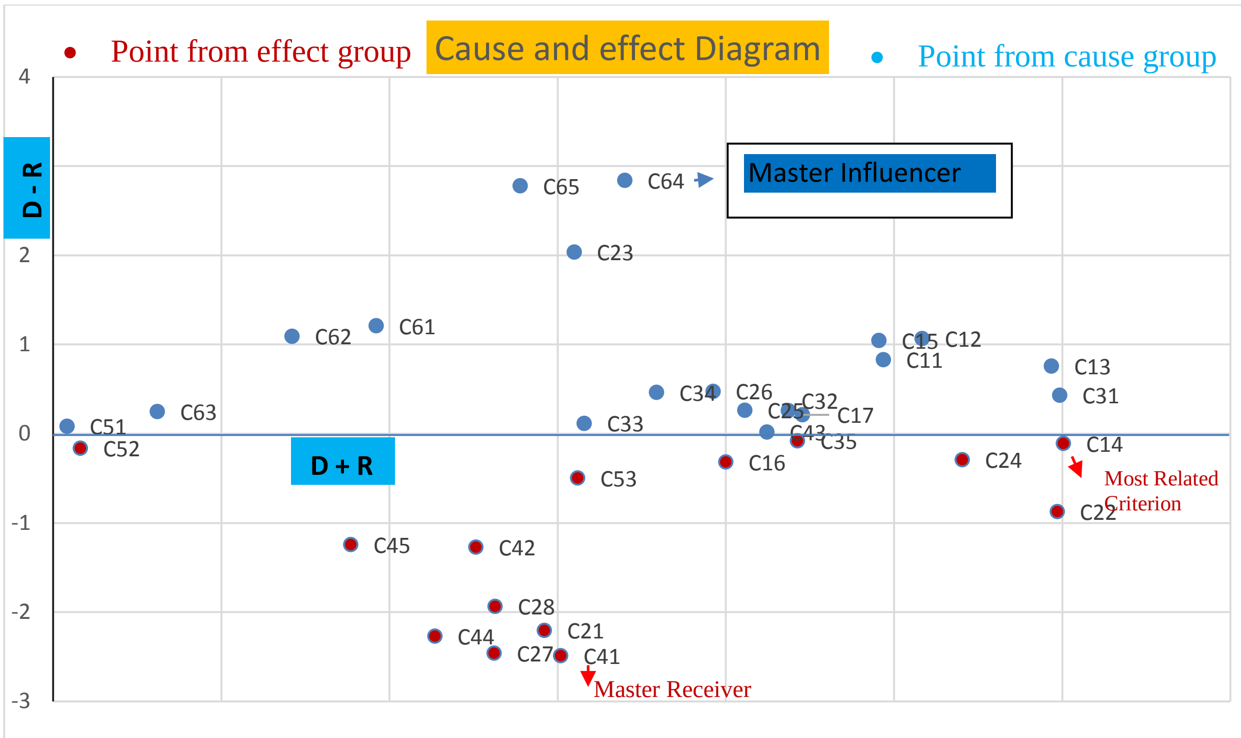


Figure 4.7: Cause and Effect Diagram

The points which are marked blue are collectively representing the cause group. The points which are marked red are collectively representing the effect group. The criterion C_{64} is a master influencer and dispatches the highest influence on the rest of the criteria. The criterion C_{41} is a master receiver and receives the highest influence from the rest of the criteria. The criterion C_{14} is the most related criterion.

The research does not drop any parameter as this is a part of the academic research, but in future undoubtedly, the educational institutions can focus more on cause group only. The ideal situation will be to apply TQM based assessment techniques only to the cause group criteria. Hence, the quality development initiatives on cause group criteria will enhance the quality of effect group criteria automatically. The criteria under the effect group are explained subsequently.

4.4.2.1.1 Impact relation under factor F1and its implication

A digraph in Figure 4.8 displays this information. The purpose of this digraph is to deduce the master influencer criterion, master receiver criterion, and the most related criterion of factor F1. The criterion C_{12}: A well-defined course structure holds the highest priority and this criterion is the master influencer of factor F1.The criterion C_{16}: Continuous and prompt feedback is acting as a master receiver .This criterion C_{16} is critically impacted by all the other criteria under this factor. The criterion C_{14}: Appropriate use of delivery methods is the most related criterion of this factor.

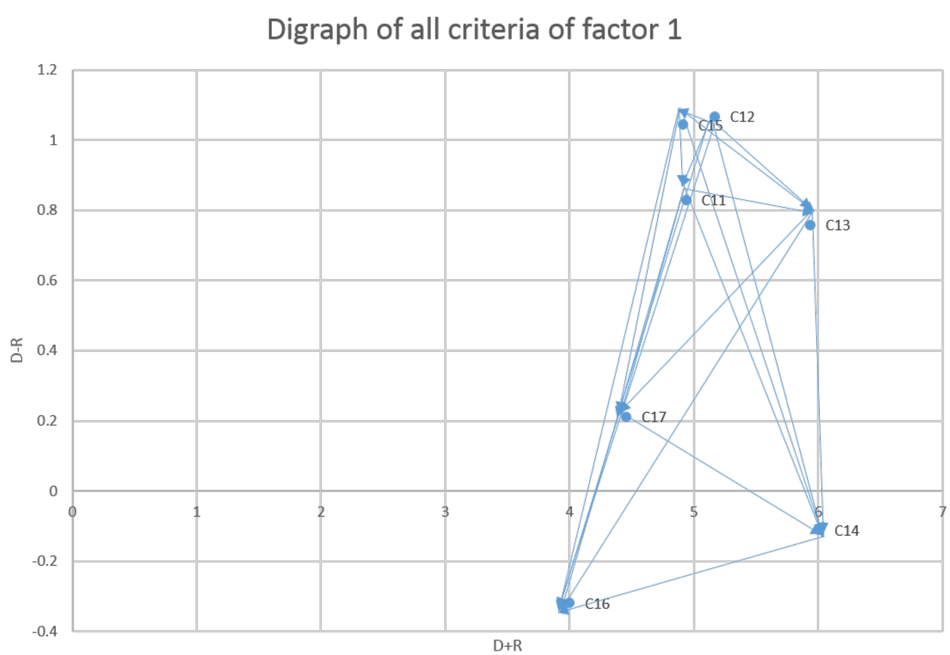


Figure 4.8: Digraph of all Criteria of Factor1

4.4.2.1.2 Impact relation under factor F2 and its implication

The purpose of this digraph is to deduce the master influencer criterion, master receiver criterion, and the most related criterion of factor F2. The criterion C_{23}: Strong leadership has dispatched the highest influence under this factor. The criterion C_{27}: Sustainability feature has received the highest influence from the other criteria of this factor. The criterion C_{27} is the master receiver of this factor. The criterion C_{24}: Self-assessment is the highly related criterion of this factor 2. The digraph in Figure 4.9 displays this information.

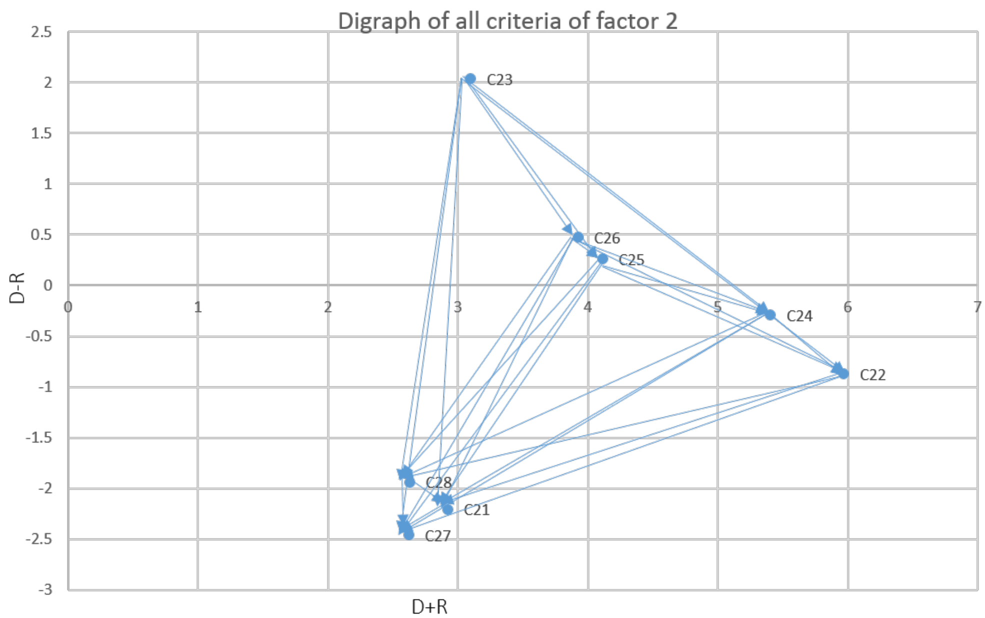


Figure 4.9: Digraph of all Criteria of Factor 2

4.4.2.1.3 Impact relation under factor F3 and its implication

The implication of this digraph in Figure 4.10 is to deduce the master influencer criterion, master receiver criterion, and the most related criterion of factor F3. The criterion C_{34}: Ease of use of LMS has the highest influence under this factor. The criterion C_{35}: An adequate online support system has received the highest influence from the other criteria of this factor. The criterion C_{35} is the master receiver of this factor. The criterion C_{31} (provision of adequate synchronous and asynchronous facility) is the highly related criterion of this factor. The digraph in Figure 4.10 displays this information.

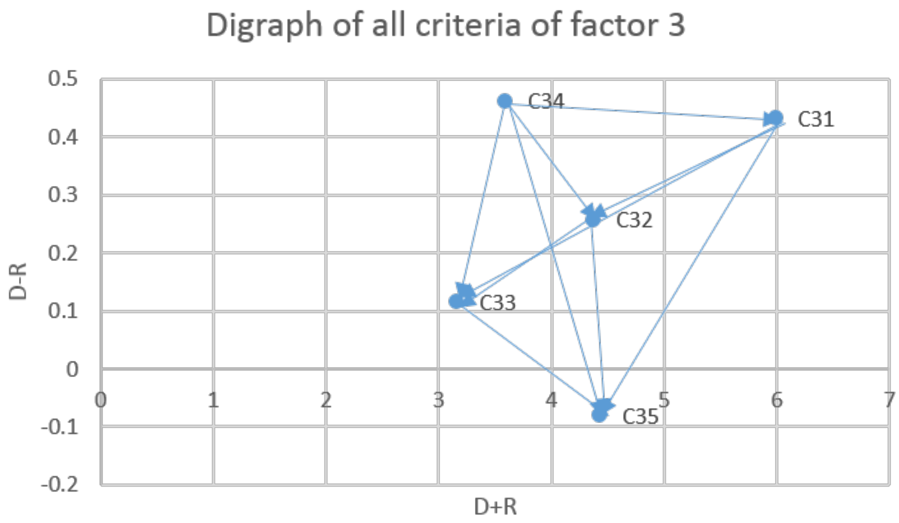


Figure 4.10: Digraph of all Criteria of Factor 3

4.4.2.1.4 Impact relation under factor F4 and its implication

The purpose of this digraph in Figure 4.11 is to deduce the master influencer criterion, master receiver criterion, and the most related criterion of factor F4. The criterion C_{43}: Clearly defined policies and procedures dispatches the highest influence under this factor. The criterion C_{41}: Collaboration with international universities received the highest influence from the other criteria of this factor. The criterion C_{41} acts as the master receiver of this factor. The criterion C_{43}: Clearly defined policies and procedures is the highly related criterion to this factor. The digraph in Figure 4.11 displays this information.

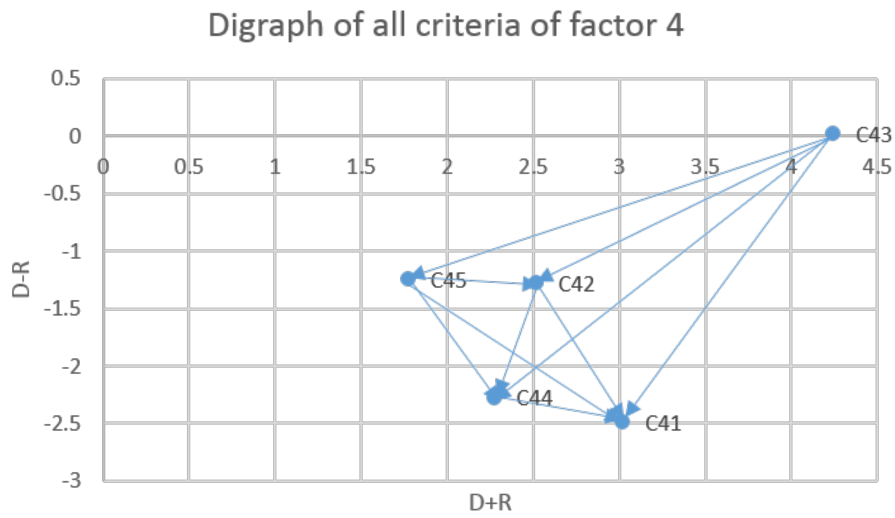


Figure 4.11: Digraph of all Criteria of Factor 4

4.4.2.1.5 Impact relation under factor F5 and its implication

The purpose of this digraph in Figure 4.12 is to obtain the master influencer criterion, master receiver criterion, and the most related criterion of factor F5. The criterion C_{51}: Lack of communication dispatches the highest influence under this factor. The criterion C_{53}: Effectiveness of interactions received the highest influence from the other criteria of this factor. The criterion C_{53} is the master receiver of this factor. The criterion C_{53} is also the highly related criterion of this factor. The digraph in Figure 4.12 displays this information.

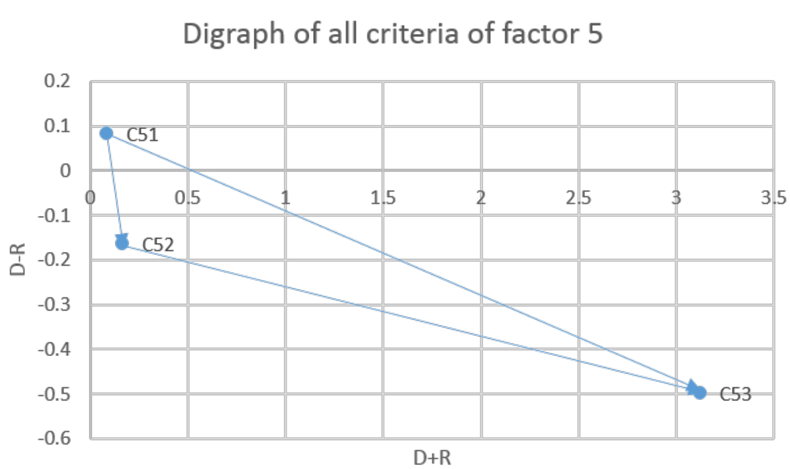


Figure 4.12: Digraph of all Criteria of Factor 5

4.4.2.1.6 Impact relation under factor F6 and its implication

The implication of this digraph in Figure 4.13 is to obtain the master influencer criterion, master receiver criterion, and the most related criterion of factor F6. The criterion C_{64}: Qualification and experience of tutor holds the highest priority. This criterion is the master influencer of factor F6.The criterion C_{63}: Resistance to embrace change by stakeholders acts as the master receiver .This criterion is critically impacted by all other criteria under this factor. The criterion $C_{64:}$ Qualification and experience of tutor is the most related criterion to this factor. The digraph in Figure 4.13 displays this information.

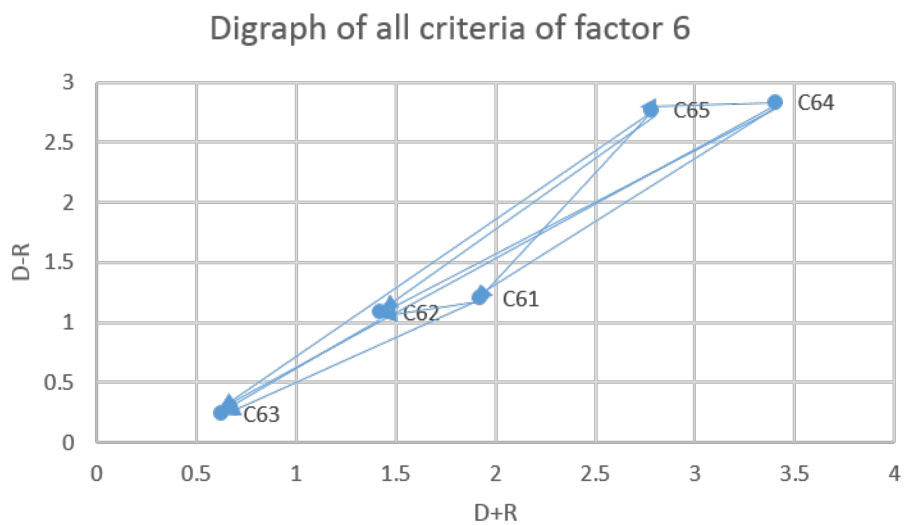


Figure 4.13: Digraph of all Criteria of Factor 6

The next analysis is the use of the MOORA method. All the criteria in the cause group and effect group are optimized against three alternatives. These three alternatives are ranked in the development of assessment framework. The full analysis is shown in detail.

4.5 Application of MOORA Method

Main decision matrix is calculated by taking the average values of the opinions of three decision makers that are named as DM1 (decision maker1), DM2 (decision maker2), and DM3 (decision maker3). The opinions of these decision makers are collected on all the criteria (C_{ij}) with respect to three alternatives: quality development initiatives (QDI) at the individual level, quality development initiatives (QDI) at the organizational level, and quality development initiatives (QDI) with the integration of the external stakeholder's level and noted as three matrices. The main decision matrices by DM1, DM2 and DM3 are represented in the following Tables: Table 4.53, Table 4.54, and Table 4. 55.

Table 4.53 Opinions of DM1 in the MOORA Method

Decision maker DM1	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	Av	EH	VH	VH	VH	VH	EH	VH	EH	VH	VH	VH	EH	VH	VH	EH	VH
QDI at organizational level	H	VH	VH	VH	H	VH	VH	VH	H	EH	ExtH	VH	VH	VH	VH	VH	VH
QDI with the external stakeholder's level	H	H	H	H	H	VH	V	VH	Av	EH	EH	H	VH	VH	VH	VH	VH
Decision maker DM1	**C_{33}**	**C_{34}**	**C_{35}**	**C_{41}**	**C_{42}**	**C_{43}**	**C_{44}**	**C_{45}**	**C_{51}**	**C_{52}**	**C_{53}**	**C_{61}**	**C_{62}**	**C_{63}**	**C_{64}**	**C_{65}**	
QDI at Individual level	VH	EH	EH	H	VH	VH	VH	EH	EH	EH	EH	EH	EH	VH	EH	EH	
QDI at organizational level	VH	EH	EH	VH	EH	VH	VH	VH	ExtH	VH	EH	VH	VH	VH	VH	VH	
QDI with the integration of external stakeholder's level	VH	EH	VH	VH	ExtH	VH	EH	VH	EH	H	EH	EH	VH	VH	H	H	

Table 4.54 Opinions of DM2 in the MOORA Method

Decision maker DM2	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	H	VH	H	VH	Av	EH	ExtH	H	EH	H	H	EH	VH	VH	H	EH	H
QDI at organizational level	H	VH	H	VH	H	EH	VH	H	H	VH	VH	VH	VH	VH	ExtH	EH	VH
QDI at the stakeholder's level	EH	VH	H	VH	VH	EH	H	H	Av	EH	VH	VH	VH	VH	VH	VH	EH
Decision maker DM2	**C_{33}**	**C_{34}**	**C_{35}**	**C_{41}**	**C_{42}**	**C_{43}**	**C_{44}**	**C_{45}**	**C_{51}**	**C_{52}**	**C_{53}**	**C_{61}**	**C_{62}**	**C_{63}**	**C_{64}**	**C_{65}**	
QDI at Individual level	EH	EH	EH	H	EH	H	EH	EH	EH	EH	EH	EH	H	H	EH	EH	
QDI at organizational level	VH	EH	EH	H	EH	VH	EH	EH	EH	VH	EH	EH	H	VH	ExtH	VH	
QDI with the integration of external stakeholder's level	H	ExtH	EH	VH	EH	EH	EH	EH	EH	H	H	H	VH	VH	H	H	

Table 4.55 Opinions of DM3 in the MOORA Method

Decision maker DM3	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	H	VH	H	VH	Av	EH	EH	H	ExH	H	H	H	EH	EH	EH	EH	VH
QDI at organizational level	H	VH	H	VH	H	EH	VH	H	H	VH	VH	VH	VH	EH	EH	VH	EH
QDI with the integration of external stakeholder's level	EH	VH	H	VH	VH	EH	H	H	H	EH	EH	EH	VH	EH	EH	VH	VH
Decision maker DM3	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
QDI at Individual level	EH	VH	EH	ExtH	EH	VH	VH	H	EH	VH	ExtH	EH	VH	EH	EH	EH	
QDI at organizational level	EH	EH	VH	EH	EH	EH	EH	EH	EH	EH	EH	VH	EH	EH	EH	EH	
QDI with the integration of external stakeholder's level	EH	VH	VH	VH	EH	VH	VH	H	EH	VH	VH	VH	VH	EH	VH	ExtH	

After assigning the crisp values by 11 point fuzzy conversion scale (as mentioned in Chapter 3, Table 3.2), the above decision Tables: Table 4.53, Table 4.54, and Table 4.55.After assigning the values , the Tables: Table 4.53, Table 4.54, and Table 4.55 are rewritten in terms of crisp values in Tables: Table 4.56, Table 4.57, and Table 4.58. The Average Initial Decision Table is formed by taking the average value of the performance ratings of the three decision makers. For example, the performance rating of C_{11} in the average initial matrix is the average value of the three values obtained from the three decision makers (.5, 0.68186, and 0.68186) which is equivalent to 0.62124. Similarly, the average values are calculated for the rest of the elements of the Table. The Average initial Table 4.59 is formed.

Now in the next step, the sum of the squares of each alternative per criterion is calculated, and afterwards the square root value of this sum is calculated as a denominator value. The normalization of the average matrix is done by dividing each criterion value with respect to three alternatives by the denominator value. For example, the vertical components of criterion C_{11} (corresponding to all three alternatives) are squared and added together in the following way:

Square values of X_{ij} = $C_{11}{}^2 = 0.62124^2 + 0.68186^2 + 0.86366^2 = 1.59678$.

The same way all the calculations i.e. ($X_{ij}{}^2$) are calculated for the rest of criteria by using the Excel software as shown in the following Table 4.60.

Afterwards, the next mathematical step is taken .The square roots of all the values of the preceding matrix are calculated by using Excel. For example, the square root of (1.59678) will be calculated as 1.26364. The same way the calculations will be done for all the rest of the criteria and shown in the following Table 4.61.

Table 4.56 Crisp Values of Opinions for DM1

Decision maker DM1	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	0.5	0.95456	0.77278	0.77278	0.77278	0.77278	0.95456	0.77278	0.95456	0.77278	0.77278	0.77278	0.95456	0.77278	0.77278	0.95456	0.77278
QDI at organizational level	0.68186	0.77278	0.77278	0.77278	0.68186	0.77278	0.77278	0.68186	0.68186	0.95456	0.86365	0.77278	0.77278	0.77278	0.77278	0.77278	0.77278
QDI with the integration of external stakeholder's level	0.68186	0.68186	0.68186	0.68186	0.68186	0.68186	0.77278	0.77278	0.5	0.95456	0.95456	0.68186	0.77278	0.77278	0.77278	0.77278	0.77278
Decision maker DM1	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
QDI at Individual level	0.77278	0.95456	0.95456	0.68186	0.77278	0.77278	0.77278	0.95456	0.95456	0.95456	0.95456	0.95456	0.95456	0.77278	0.95456	0.95456	
QDI at organizational level	0.77278	0.95456	0.95456	0.77278	0.95456	0.77278	0.77278	0.77278	0.86365	0.77278	0.95456	0.77278	0.77278	0.77278	0.77278	0.77278	
QDI with the integration of external stakeholder's level	0.77278	0.95456	0.77278	0.77278	0.86365	0.77278	0.95456	0.77278	0.77278	0.68186	0.95456	0.95456	0.77278	0.77278	0.68186	0.68186	

Table 4.57 Crisp Values of Opinions of DM2

Decision maker DM2	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	0.68186	0.77278	0.68186	0.77278	0.5	0.95456	0.86365	0.68186	0.95456	0.68186	0.68186	0.95456	0.77278	0.77278	0.68186	0.95456	0.68186
QDI at organizational level	0.68186	0.77278	0.68186	0.77278	0.68186	0.95456	0.77278	0.68186	0.68186	0.77278	0.77278	0.77278	0.77278	0.77278	0.86365	0.95456	0.77278
QDI with the integration of external stakeholder's level	0.95456	0.77278	0.68186	0.77278	0.77278	0.95456	0.68186	0.68186	0.77278	0.95456	0.77278	0.77278	0.77278	0.77278	0.77278	0.77278	0.95456

Decision maker DM2	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
QDI at Individual level	0.95456	0.95456	0.95456	0.68186	0.95456	0.68186	0.95456	0.95456	0.95456	0.95456	0.95456	0.95456	0.68186	0.68186	0.95456	0.95456
QDI at organizational level	0.77278	0.95456	0.95456	0.68186	0.95456	0.77278	0.95456	0.95456	0.95456	0.77278	0.95456	0.95456	0.68186	0.77278	0.86365	0.77278
QDI with the integration of external stakeholder's level	0.68186	0.86365	0.95456	0.77278	0.95456	0.95456	0.95456	0.95456	0.95456	0.68186	0.68186	0.68186	0.77278	0.77278	0.68186	0.68186

Table 4.58 Crisp Values of opinions of DM3

Decision maker DM3	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	0.68186	0.77278	0.68186	0.77278	0.5	0.95456	0.95456	0.68186	0.68186	0.68186	0.68186	0.68186	0.95456	0.95456	0.95456	0.95456	0.77278
QDI at organizational level	0.68186	0.77278	0.68186	0.77278	0.68186	0.95456	0.77278	0.68186	0.68186	0.77278	0.77278	0.77278	0.77278	0.77278	0.95456	0.77278	0.95456
QDI with the integration of external stakeholder's level	0.95456	0.77278	0.68186	0.77278	0.77278	0.95456	0.68186	0.68186	0.77278	0.95456	0.95456	0.95456	0.77278	0.95456	0.95456	0.77278	0.77278
Decision maker DM3	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
QDI at Individual level	0.95456	0.77278	0.95456	0.86365	0.95456	0.77278	0.77278	0.68186	0.95456	0.77278	0.86365	0.95456	0.77278	0.95456	0.95456	0.95456	
QDI at organizational level	0.95456	0.95456	0.77278	0.95456	0.95456	0.95456	0.95456	0.95456	0.95456	0.95456	0.95456	0.77278	0.95456	0.95456	0.95456	0.95456	
QDI with the integration of external stakeholder's level	0.95456	0.77278	0.77278	0.77278	0.95456	0.77278	0.77278	0.68186	0.95456	0.77278	0.77278	0.77278	0.77278	0.95456	0.77278	0.86365	

Table 4.59 ***(X_{ij})*** Average value of opinions of Average of DM1, DM2, and DM3

Average of DM1, DM2, DM3 *(X_{ij})* value	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	0.62124	0.83337	0.71217	0.77278	0.59093	0.89397	0.92426	0.71217	0.86366	0.71217	0.71217	0.80307	0.89397	0.83337	0.80307	0.95456	0.74247
QDI at organizational level	0.68186	0.77278	0.71217	0.77278	0.68186	0.89397	0.77278	0.68186	0.68186	0.83337	0.80307	0.77278	0.77278	0.77278	0.86366	0.83337	0.83337
QDI with the integration of external stakeholder's level	0.86366	0.74247	0.68186	0.74247	0.74247	0.86366	0.71217	0.71217	0.68185	0.95456	0.89397	0.80307	0.77278	0.83337	0.83337	0.77278	0.83337
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
QDI at Individual level	0.89397	0.89397	0.95456	0.74246	0.89397	0.74247	0.83337	0.86366	0.95456	0.89397	0.92426	0.95456	0.80307	0.80307	0.95456	0.95456	
QDI at organizational level	0.83337	0.95456	0.89397	0.80307	0.95456	0.83337	0.89397	0.89397	0.92426	0.83337	0.95456	0.83337	0.80307	0.83337	0.86366	0.83337	
QDI with the integration of external stakeholder's level	0.80307	0.86366	0.83337	0.77278	92426	0.83337	0.89397	0.80307	0.89397	0.71217	0.07	0.80307	0.77278	0.83337	0.71217	0.74246	

Table 4.60 Sum of all square values of X_{ij}

Sum of all X_{ij}^2	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	1.59678	1.84297	1.4793	1.74564	1.36539	2.34426	1.95862	1.4793	1.67577	2.11288	1.95128	1.88702	1.99355	1.98621	2.08534	2.20288	1.94029
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
	2.1386	2.45628	2.40487	1.79335	2.56461	1.94029	2.29286	2.19	2.56461	2.00087	2.41035	2.25061	1.88702	2.03394	2.16428	2.15694	0

Table 4.61 Square Root of all X_{ij}^2

Square root of all X_{ij}^2	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	1.26364	1.35756	1.21626	1.32123	1.1685	1.5311	1.39951	1.21626	1.29451	1.45357	1.39688	1.37369	1.41193	1.40933	1.44407	1.48421	1.39294
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
	1.4624	1.56725	1.55077	1.33916	1.60144	1.39294	1.51422	1.47987	1.60144	1.41452	1.55253	1.5002	1.37369	1.42616	1.47115	1.46865	0

Now, the next mathematical step is taken in which the normalized matrix is calculated by dividing all the X_{ij} values (related to each criterion) for all three alternatives from Table 4.59 with the corresponding values of square root of all $X_{ij}{}^2$ (related to each criterion)) for each criterion in Table 4.61.

For example, the value of criterion C_{11}, 0.62124 (QDI at the individual level) from the Table 4.59 is divided by 1.26364 (from Table 4.61) and the resultant value will be 0.49163. The same way the calculations will be done for the rest of the criteria and results are shown in the following Table 4.62.The normalized matrix is given in Table 4.62.

Table 4.62 Normalized Matrix

Normalized matrix for Xij	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	0.49163	0.61388	0.58554	0.5849	0.50571	0.58387	0.66042	0.58554	0.66717	0.48994	0.50983	0.58461	0.63315	0.59133	0.55611	0.64314	0.53303
QDI at organizational level	0.5396	0.56924	0.58554	0.5849	0.58353	0.58387	0.55218	0.56062	0.52673	0.57333	0.5749	0.56256	0.54732	0.54833	0.59808	0.56149	0.59828
QDI at the external Stakeholder's level	0.68347	0.54692	0.56062	0.56196	0.63541	0.56408	0.50887	0.58554	0.52673	0.6567	0.63997	0.58461	0.54732	0.59133	0.5771	0.52067	0.59828

Normalized matrix for Xij	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
QDI at Individual level	0.6113	0.5643	0.6155	0.5385	0.5521	0.5330	0.5504	0.5836	0.5896	0.6320	0.5825	0.6363	0.5846	0.5631	0.6410	0.6431
QDI at organizational level	0.5699	0.6026	0.5765	0.6072	0.5896	0.5983	0.5904	0.6041	0.5896	0.5892	0.6220	0.5555	0.5846	0.5843	0.6003	0.5615
QDI at the external Stakeholder's level	0.5491	0.5643	0.5374	0.5843	0.5896	0.5983	0.5904	0.5427	0.5521	0.5035	0.5233	0.5353	0.5626	0.5843	0.4782	0.5207

This normalized matrix from Table 4.62 is used further during the application of the MOORA method. The next mathematical technique is used on the normalized matrix to find the weights of all criteria. The SDV method and the Entropy method are used for finding the weights because both these methods are suitable when no preference is shown during the selection of criterion and related alternatives.

In this research, no preference among the criteria is mentioned by the decision maker. Hence, the standard deviation method will be applied to allocate the weights of the different criteria. The weight of the criterion has a practical implication. It gives an idea about the importance of criterion as per its numerical value. The higher numerical value of weight signifies more importance for criterion as compared to the lower numerical value of weight of criterion.

4.5.1 Results of Standard deviation Method

This method starts with the range standardization step. This step transforms different scales and units as used in various criteria into common measurable units. Thus, weights can be compared (being in the same measurable units).The following steps are taken:

Step 1:

Find the value of $x_{ij}{}^{*} = \dfrac{\mathrm{xij} - \min\limits_{1 \le j \le n} xij}{\max\limits_{1 \le j \le n} xij - \min\limits_{1 \le j \le n} xij}$

Where x_{ij} are the values of the normalized matrix from Table 4.63.The values of $x_{ij}{}^{*}$ are calculated using the above formula. In this formula, the maximum value of the criterion (j) where $1 \le j \le n$ is represented as max x_{ij}, and the minimum value of the criterion is represented as min x_{ij}. The matrix after the range standardization (by the use of above formula) is represented as $D' = (x_{ij}\boldsymbol{*})$. All values of $x_{ij}\boldsymbol{*}$ in this matrix will be in the range of $0 \le x_{ij}{}^{*} \le 1$ and are shown in the Table 4.63.

In the next mathematical step, the standard deviation (SDV_j) for each criterion of the normalized matrix is calculated independently using Excel software. The results are displayed in Table 4.64. Afterwards, the next mathematical step is to calculate the weight (w_j) for each criterion by the help of following formula.

$$w_j = SDV_j / \sum_{j=1}^{j=n} SDV_j$$

But, in order to apply the above formula, the sum of all the standard deviation values ($\sum_{j=1}^{j=n} SDV_j$) is calculated as 18.25103(sum of all the standard deviation values) from Table 4.64. Then SDV_j of each criterion is divided by the sum of standard deviations of all criteria 18.25103. For example, the weight of the criterion C_{11} is calculated by dividing the corresponding standard deviation criterion value 0.520407 by 18.25103.The weight of criterion is calculated as 0.028541. The rest of the weights of all criteria are also calculated in the same way and are displayed in Table 4.65.

The weights for all criteria in Table 4.65 are multiplied by the corresponding values in the normalized matrix from Table 4.62. For example, the weight of the criterion for C_{11}, 0.02851 will be multiplied by the corresponding values of all alternatives of criterion C_{11} of the normalized matrix. In the same way, the calculations will be done for the rest of the criteria. The criteria that are coming under the benefit criteria category will be represented as (+) sign and the criteria which are coming under the cost criteria category will be represented as (-) .The Table 4.66 represents this information . All criteria with (+) mark are part of benefit criteria group and all criteria with (-) mark are part of cost criteria group.

In the next step, all the values of $w_i * x_{ij}^*$ for all the alternatives are calculated. The result is shown in Table 4.67. The last mathematical step is one in which all the values of $w_i * x_{ij}^*$ **(**all the benefit criteria) are added for all the alternatives. Similarly, all the values of $w_i * x_{ij}^*$ **(**all the cost criteria) are added for all the alternatives. The net composite score is obtained by subtracting the final score of cost criteria from the final score of benefit criteria. The results are shown in Table 4.68.

Table 4.63 Standardized Matrix

$D^{'} = (x_{ij}*)$	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	0	1	1	1	0	1	1	1	1	0	0	1	1	1	0	1	0
QDI at organizational level	0.25006	0.33341	1	1	0.60004	1	0.28579	0	0.000037	0.50004	0.50003	0	0	0	1	0.33333	1
QD at the Stakeholder's level	1	0	0	0	1	0	0	1	0	1	1	1	0	1	0.50013	0	1

$D^{'} = (x_{ij}*)$	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
QDI at Individual level	1	0.33337	1	0	0	0	0	0.66659	1	1	0.79998	1	0	0	1	1
QDI at organizational level	0.33341	1	0.5	1	1	1	1	1	0.499912	0.6667	1	0.20005	0	1	0.62501	0.42864
QDI at the Stakeholder's level	0	0	0	0.50029	0.49991	1	1	0	0	0	0	0	1	1	0	0

Table 4.64 Standard Deviations

Standard deviations of x_{ij}*	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	0.52041	0.50917	0.57735	0.57735	0.50332	0.57735	0.51507	0.57735	0.57734	0.5	0.5	0.57735	0.57735	0.57735	0.5	0.50918	0.57735
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
	0.52041	0.57735	0.5	0.763619	0.57735	0.57735	0.57735	0.50917	0.5	0.50918	0.52915	0.52914	0.57735	0.57735	0.50518	0.50169	

Table 4.65 Weights of Criteria

Weights of criteria by dividing SDVj for each criterion with 18.25103	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	0.02851	0.02790	0.03163	0.03163	0.02758	0.03163	0.02851	0.03163	0.03163	0.02740	0.02790	0.03163	0.03163	0.03163	0.03163	0.02790	0.03163
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
	0.028514	0.031634	0.027396	0.04184	0.031634	0.031634	0.031634	0.027898	0.031633	0.027899	0.027578	0.028992	0.031634	0.031634	0.028515	0.027898	

Table 4.66 List of Benefit and Cost Criteria

Criterion	Criterion in symbol	Benefit Criteria	Cost Criteria
Problem based learning	C_{11}	(+)	_
Well defined course structure	C_{12}	(+)	_
Right blend of f2f and online learning activities	C_{13}	(+)	_
Appropriate use of delivery methods	C_{14}	(+)	_
Support of tutor	C_{15}	(+)	_
Prompt and continuous feedback	C_{16}	(+)	_
personalization of course content and course structure	C_{17}	(+)	_
Return on investments	C_{21}	(+)	_
Self-assessment	C_{22}	(+)	_
Strong leadership	C_{23}	(+)	_
Evaluation by international standards	C_{24}	(+)	_
Formal and informal kind of assessment	C_{25}	(+)	_
F2f discussion of student’s performance	C_{26}	(+)	_
Sustainability feature	C_{27}	(+)	_
Social and Networking feature	C_{28}	(+)	_
Provision of adequate (synchronous and asynchronous) facility	C_{31}	(+)	–
Modernized technology equipped infrastructure	C_{32}	(+)	_
Availability of communication services (24 x 7)	C_{33}	(+)	_
Ease of use of learning management system	C_{34}	(+)	_
An adequate online support system (e-library, online orientation and experts online	C_{35}	(+)	–
Collaboration with international universities	C_{41}	(+)	_
Awarding an authoritative degree	C_{42}	(+)	_
Clearly defined policies and procedures	C_{43}	(+)	
Reduction of carbon emission	C_{44}	_	(-)
Improvement of retention rate	C_{45}	(+)	
Lack of communication	C_{51}	_	(-)
Feeling of isolation	C_{52}	_	(-)
Effectiveness of interactions (student-student, student- teacher , student- content)	C_{53}	(+)	–
Prior knowledge of computers	C_{61}	(+)	_
Lack of sufficient funds and resources	C_{62}	_	(-)
Resistance to embrace change by stakeholders	C_{63}	_	(-)
Qualification and experience of tutor	C_{64}	(+)	_
A well explained content	C_{65}	(+)	_

Table 4.67 Weights multiplied by x_{ij}^*

weights multiplied by x_{ij}^*	C_{11}(+)	C_{12} (+)	C_{13}(+)	C_{14}(+)	C_{15}(+)	C_{16}(+)	C_{17}(+)	C_{21}(+)	C_{22}(+)	C_{23}(+)	C_{24}(+)	C_{25}(+)	C_{26}(+)	C_{27}(+)	C_{28}(+)	C_{31}(+)	C_{32}(+)
QDI at Individual level	0.014018	0.017126	0.018523	0.018502	0.013947	0.01847	0.019172	0.018523	0.021105	0.013422	0.014046	0.018493	0.020029	0.018706	0.018034	0.017943	0.016862
QDI at Organisational level	0.015386	0.015881	0.018523	0.018502	0.016093	0.01847	0.015521	0.017735	0.016662	0.015707	0.016437	0.017796	0.017314	0.017346	0.018034	0.015665	0.018926
QDI with the integration at the Stakeholder's level	0.019488	0.015258	0.017735	0.017777	0.017523	0.017844	0.014303	0.018523	0.016662	0.017991	0.017632	0.018493	0.017314	0.018706	0.018715	0.014526	0.018926

weights multiplied by x_{ij}^*	C_{33}(+)	C_{34}(+)	C_{35}(+)	C_{41}(+)	C_{42}(+)	C_{43}(+)	C_{44}(-)	C_{45}(+)	C_{51}(-)	C_{52}(-)	C_{53}(+)	C_{61}(+)	C_{62}(-)	C_{63}(-)	C_{65}(+)	C_{64}(+)
QDI at Individual level	0.017431	0.017852	0.016863	0.022529	0.017466	0.016862	0.01741	0.016281	0.01865	0.017632	0.016064	0.018447	0.018493	0.017813	0.018278	0.017943
QDI at Organisational level	0.016249	0.019062	0.015793	0.025404	0.01865	0.018926	0.018676	0.016853	0.01865	0.016437	0.017153	0.016105	0.018493	0.018485	0.017118	0.015665
QDI at the Stakeholder's level	0.015658	0.017852	0.014722	0.024446	0.01865	0.018926	0.018676	0.015139	0.017466	0.014046	0.014431	0.01552	0.017796	0.018485	0.013637	0.014525

4.5.1.1 Implication of Final Composite Score

In the following Table 4.68, the composite scores for all the alternatives are listed. The final composite score implies ranking of the alternatives. The highest value of composite score signifies Rank1 for the alternative. This Rank 1 suggests that the QDI at the individual level needs to be implemented with the highest priority for the BLE for the higher education sector.

The alternative with the second highest composite score is ranked at the second place. The Rank 2 alternative suggests that the QDI at the organizational level needs to be implemented with the second highest priority for the blended learning environment for the higher education sector. The alternative with the least composite score is ranked at third place. The Rank 3 alternative suggests that the quality development initiative at the integration of the external stakeholder's level needs to be implemented with the least priority for the BLE for the higher education sector.

Thus, in my opinion, in real situations, the importance of this result is immense. As with this result, the institutions can prioritize their efforts in implementing the quality development initiatives for assessing and enhancing the quality of the BLE. This can give management a big relief in deciding and planning their approach for achieving the objective of assessing and enhancing the quality of the BLE. The final ranking of alternatives is displayed in Table 4.68a.The Table 4.68a is obtained by involving all the criteria. But when this method is applied again on the cause criteria only then Table 4.68b is obtained. The ranking comes out similar.

Table 4.68a Final Ranking

	Benefit	Cost	Composite score	
QDI at Individual level	0.492936	0.089998	0.492936	**Rank 1**
QDI at Organizational level	0.486974	0.090741	0.486974	**Rank2**
QDI at the integration of external Stakeholder's level	0.480921	0.086469	0.480921	**Rank3**

Table 4.68b Final Ranking (Cause Criteria)

Cause Criteria				
Use of SDV method	Benefit	Cost	Net	
QDI at individual level	0.280932	0.054956	0.225976	Rank1
QDI at organizational level	0.260749	0.055628	0.20512	Rank2
QDI at the level by integrating external stakeholders	0.258669	0.053747	0.204922	Rank3

In the next phase of research, the Entropy method is used to find out the weights of the criteria. The next section explains the results of Entropy Method.

4.5.2 Results of Entropy Method

The steps for the Entropy weight method are explained in the following way:

Step 1:

Matrix after range standardization in Table 4.63 is used as the initial matrix for X_{ij} and Entropy method is applied on it. The range standardization has converted the effects of different scales and units among various criteria into a common measurable unit. So, weights can be compared fairly. The next mathematical step is to add 1 to all the elements of X_{ij} .The results of matrix 1+ X_{ij} is represented in Table 4.69.The next mathematical step is to add all the weights for individual criterion ie.to calculate $\sum_{i=1}^{i=m}(1+x_{ij}^{*})$. The results are shown in Table 4.70.

Step 2:

In this step, the following formula is used to calculate the values of f_{ij} for all criteria i = 1, 2……m and j = 1, 2….n, for all alternatives. The values of f_{ij} are displayed in Table 4.71.

$$f_{ij} = \frac{1+x_{ij}^{*}}{\sum_{i=1}^{i=m}(1+x_{ij}^{*})}$$

In the next mathematical step 3, the following formula for Hj is applied. An outcome is displayed for ln f_{ij} and Sum ($fij * \ln f_ij$) is displayed in Table 4.72 and Table 4.73 respectively. The values of

H_j are displayed in Table 4.74. The results of G_j are displayed in Table 4.75. The application of the following formula provides the amount of variation present for all the criteria.

Table 4.69 Matrix 1+ X_{ij}

1+ X_{ij}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	1	2	1	2	1	2	2	2	2	1	1	1	2	2	1	2	1
QDI at organizational level	1.25006	1.33341	1	2	1.60004	2	1.25006	1	1.00004	1.50004	1.6667	2	1	1	1	1.333	2
QD at the Stakeholder's level	2	1	2	1	2	1	1	2	1	2	2	1	1	2	2	1	2

1+ X_{ij}	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
QDI at Individual level	2	1	2	1	2	1	1	1.66659	2	2	1.60003	2	1	2	2	2
QDI at organizational level	1.33341	2	1.5	2.49967	1	2	2	2	2	1.6667	2	1.20005	1	1	1.75002	1.33341
QDI at the Stakeholder's level	1	1	1	2	1	2	2	1	1	1	1	1	2	1	1	1

Table 4.70 Values of $\sum_{i=1}^{i=m}(\mathbf{1} + \boldsymbol{x_{ij}}^{*})$

	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	4.25006	**4.33341**	**4**	**5**	**4.60004**	**5**	**4.25006**	**5**	**4.00004**	**4.50004**	**4.6667**	**4**	**4**	**5**	**4**	**4.33333**	**5**
	C_{33}	**C_{34}**	**C_{35}**	**C_{41}**	**C_{42}**	**C_{43}**	**C_{44}**	**C_{45}**	**C_{51}**	**C_{52}**	**C_{53}**	**C_{61}**	**C_{62}**	**C_{63}**	**C_{64}**	**C_{65}**	
	4.33341	**4**	**4.5**	**5.49967**	**4**	**5**	**5**	**4.66659**	**5**	**4.6667**	**4.60003**	**4.20005**	**4**	**4**	**4.75002**	**4.33341**	

Table 4.71 Value of f_{ij}

f_{ij}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	0.23529	0.46153	0.4	0.4	0.21739	0.4	0.46666	0.4	0.5	0.22222	0.22222	0.4	0.5	0.4	0.22222	0.46154	0.2
QDI at Organizational level	0.29413	0.3077	0.4	0.4	0.34783	0.4	0.30001	0.2	0.25001	0.33334	0.33334	0.2	0.25	0.2	0.44443	0.30769	0.4
QDI at the Stakeholder's level	0.47058	0.23077	0.2	0.2	0.43478	0.2	0.23333	0.4	0.25	0.44444	0.44444	0.4	0.25	0.4	0.33335	0.23077	0.4

f_{ij}	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
QDI at Individual level	0.46153	0.3077	0.44444	0.22221	0.22223	0.2	0.2	0.35713	0.44445	0.42857	0.375	0.47618	0.25	0.2	0.43243	0.45161
QDI at Organizational level	0.3077	0.46153	0.33333	0.44442	0.44445	0.4	0.4	0.42858	0.33332	0.35715	0.41667	0.28572	0.25	0.4	0.35135	0.32259
QDI at the Stakeholder's level	0.23077	0.23077	0.22222	0.33338	0.33332	0.4	0.4	0.21429	0.22223	0.21428	0.20833	0.23809	0.5	0.4	0.21622	0.2258

Table 4.72 Values in ln *fij*

Value of ln *fij*	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
QDI at Individual level	**-1.4469**	**-0.7732**	**-0.9163**	**-0.9163**	**-1.5261**	**-0.9163**	**-0.7622**	**-0.9163**	**-0.6932**	**-1.5041**	**-1.5041**	**-0.9163**	**-0.6931**	**-0.9163**	**-1.5041**	**-0.7732**	**-1.6094**
QDI at Organisational level	**-1.2237**	**-1.1786**	**-0.9163**	**-0.9163**	**-1.056**	**-0.9163**	**-1.2039**	**-1.6094**	**-1.3863**	**-1.0986**	**-1.0986**	**-1.6094**	**-1.3863**	**-1.6094**	**-0.811**	**-1.1787**	**-0.9163**
QDI at the Stakeholder's level	**-0.7538**	**-1.4664**	**-1.6094**	**-1.6094**	**-0.8329**	**-1.6094**	**-1.4553**	**-0.9163**	**-1.3863**	**-0.8109**	**-0.8109**	**-0.9163**	**-1.3863**	**-0.9163**	**-1.0986**	**-1.4663**	**-0.9163**
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
QDI at Individual level	**-0.7732**	**-1.1786**	**-0.8109**	**-1.5041**	**-1.5041**	**-1.6094**	**-1.6094**	**-1.0296**	**-0.8109**	**-0.8473**	**-0.9808**	**-0.7419**	**-1.3863**	**-1.6094**	**-0.8383**	**-0.7949**	
QDI at Organisational level	**-1.1786**	**-0.7732**	**-1.0986**	**-0.811**	**-0.8109**	**-0.9163**	**-0.9163**	**-0.8473**	**-1.0987**	**-1.0296**	**-0.8755**	**-1.2527**	**-1.3863**	**-0.9163**	**-1.046**	**-1.1314**	
QDI at the Stakeholder's level	**-1.4664**	**-1.4663**	**-1.5041**	**-1.0985**	**-1.0987**	**-0.9163**	**-0.9163**	**-1.5404**	**-1.5041**	**-1.5405**	**-1.5686**	**-1.4351**	**-0.6931**	**-0.9163**	**-1.5315**	**-1.4881**	

Table 4.73 Value of Sum of f_{ij}*lnf_{ij}

Sum of f_{ij}*lnf_{ij}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	-1.0551	-1.0579	-1.0549	-1.0549	-1.0612	-1.0549	-1.0564	-1.0549	-1.0397	-1.0609	-1.0609	-1.0549	-1.0397	-1.0549	-1.0609	-1.0579	-1.0549
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
	-1.0579	-1.0579	-1.0609	-1.0609	-1.0609	-1.0549	-1.0549	-1.0609	-1.0609	-1.0609	-1.0594	-1.0529	-1.0397	-1.0549	-1.0612	-1.06	

Table 4.74 Value of H_j

	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
H_j : amount of variation	**1.0551**	**1.05791**	**1.05492**	**1.05492**	**1.06121**	**1.05492**	**1.05643**	**1.05492**	**1.03972**	**1.06086**	**1.06086**	**1.05492**	**1.03972**	**1.05492**	**1.06086**	**1.05791**	**1.05492**
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
	1.05791	**1.03972**	**1.06086**	**1.03621**	**1.03972**	**1.05492**	**1.05492**	**1.06094**	**1.05492**	**1.06094**	**1.06121**	**1.05293**	**1.03972**	**1.03972**	**1.06012**	**1.05791**	

Table 4.75 Value of *1-Hj = Gj*

	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	-0.0551	-0.0579	-0.0549	-0.0549	-0.0612	-0.0549	-0.0564	-0.0549	-0.0397	-0.0609	-0.0609	-0.0549	-0.0397	-0.0549	-0.0609	-0.0579	-0.0549
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	
	-0.0579	-0.0579	-0.0609	-0.0609	-0.0609	-0.0549	-0.0549	-0.0609	-0.0609	-0.0609	-0.0594	-0.0529	-0.0397	-0.0549	-0.0612	-0.06	

The Table 4.75 provides the value of G_j. The higher value of G_j means higher value of weight for the particular criterion (j).The weight (w_j) of the criterion is explained in the following step.

In the last mathematical step, the weight of the criterion is calculated by the following method:

$$w_j = \frac{\boldsymbol{Gj}}{\sum_{j=1}^{j=n} \boldsymbol{Gj}}$$

The higher value of G_j for each criterion j = 1, 2, 3…n will lead to the higher value of w_j .The results of *wj* are given in Table 4.76.

In the last step, the weights of criteria are multiplied with the values of criteria from Table 4.63. This scores belong to either to the group of benefit criteria (represented with (+) sign) or to the group of cost criteria (represented with (-) sign). The results of this computation are given in Table 4.77.

Table 4.76 Weights

Weights	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	0.03213	**0.03377**	**0.02316**	**0.03203**	**0.03569**	**0.03203**	**0.03213**	**0.03203**	**0.02316**	**0.03549**	**0.03554**	**0.02316**	**0.02316**	**0.03203**	**0.02316**	**0.03377**	**0.03203**

Weights	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}
	0.03377	**0.02316**	**0.03549**	**0.02112**	**0.02316**	**0.03203**	**0.03203**	**0.03554**	**0.03203**	**0.03554**	**0.03569**	**0.03086**	**0.02316**	**0.02316**	**0.03506**	**0.03377**

Table 4.77 Weights multiplied by *Xij*

Weights * xij	C_{11}(+)	C_{12} (+)	C_{13}(+)	C_{14}(+)	C_{15}(+)	C_{16}(+)	C_{17}(+)	C_{21}(+)	C_{22}(+)	C_{23}(+)	C_{24}(+)	C_{25}(+)	C_{26}(+)	C_{27}(+)	C_{28}(+)	C_{31}(+)	C_{32}(+)
QDI at Individual level	**0.0158**	**0.02073**	**0.01356**	**0.01873**	**0.01805**	**0.0187**	**0.0216**	**0.01875**	**0.01545**	**0.01739**	**0.01789**	**0.01354**	**0.01467**	**0.01894**	**0.0132**	**0.02172**	**0.01707**
QDI at Organisational level	**0.01734**	**0.01922**	**0.01356**	**0.01873**	**0.02083**	**0.0187**	**0.01749**	**0.01795**	**0.0122**	**0.02035**	**0.02094**	**0.01303**	**0.01268**	**0.01756**	**0.0132**	**0.01896**	**0.01916**
QDI at the externalStakeholder's level	**0.02196**	**0.01847**	**0.01299**	**0.018**	**0.02268**	**0.01806**	**0.01612**	**0.01875**	**0.0122**	**0.0233**	**0.02246**	**0.01354**	**0.01268**	**0.01894**	**0.0137**	**0.01758**	**0.01916**

	C_{33}(+)	C_{34}(+)	C_{35}(+)	C_{41}(+)	C_{42}(+)	C_{43}(+)	C_{44}(-)	C_{45}(+)	C_{51}(-)	C_{52}(-)	C_{53}(+)	C_{61}(+)	C_{62}(-)	C_{63}(-)	C_{64}(+)	C_{65}(+)
QDI at Individual level	**0.020642**	**0.013071**	**0.021844**	**0.011371**	**0.012788**	**0.01707**	**0.017625**	**0.02074**	**0.018881**	**0.02246**	**0.020791**	**0.019637**	**0.013541**	**0.013042**	**0.022472**	**0.021717**
QDI at Organisational level	**0.019243**	**0.013957**	**0.020457**	**0.012822**	**0.013655**	**0.01916**	**0.018907**	**0.021468**	**0.018881**	**0.020937**	**0.0222**	**0.017144**	**0.013541**	**0.013535**	**0.021045**	**0.01896**
QDI at the external Stakeholder's level	**0.018543**	**0.013071**	**0.019071**	**0.012338**	**0.013655**	**0.01916**	**0.018907**	**0.019285**	**0.017682**	**0.017892**	**0.018677**	**0.01652**	**0.01303**	**0.013535**	**0.016765**	**0.017581**

The scores of the benefit criteria for all the alternatives are added .Similarly, the scores of the cost criteria for all alternatives are added. The composite score is obtained by subtracting the total cost criteria value from the total benefit criteria value as shown in the following Table 4.78a.The net results of ranking of alternatives for cause criteria are displayed in Table 4.78b.

Table 4.78a Net Results of Ranking of Alternatives for all criteria

Alternatives	Benefits		Costs		Net result	
QDI at Individual level	0.4997		0.08328		0.41643	**Rank 1**
QDI at Organizational level	0.49513		0.08288		0.41226	**Rank 2**
QDI at the external Stakeholder's level	0.48627		0.07887		0.4074	**Rank 3**

Table 4.78b Net Results of Ranking of Alternatives for cause criteria

Cause Criteria				
Use of Entropy method	Benefit	Cost	Net	
QDI at individual level	0.27838	0.04546	0.23292	Rank 1
QDI at organizational level	0.27598	0.04596	0.23003	Rank 2
QDI at the level by integrating external stakeholders	0.27487	0.04425	0.23063	Rank 3

The implication of ranking is being explained in the next subsection.

4.5.2.1 Implication of Ranking

The alternative with the highest value of the composite score is ranked at the first place. This Rank 1 alternative suggests that the QDI at the individual level needs to be implemented with the highest priority for the BLE for the higher education sector. The alternative with the second highest composite score is ranked at the second place. The Rank 2 alternative suggests that the QDI at the organizational level needs to be implemented with the second highest priority for the blended learning environment for the higher education sector. The alternative with the least composite score is ranked at the third place. The Rank 3 alternative suggests that the QDI at the stakeholder's level needs to be implemented with the least priority for the BLE for the higher education sector. The same ranking in Table 4.78a and 4.78b represents the robustness of ranking. In the next section, the robustness of the ranking is validated with the help of sensitivity analysis.

4.6 Results of Sensitivity Analysis

The sensitivity analysis is conducted to see the criticality degree of criterion, C_{64} (Qualification and experience of tutor), which turns out as the most critical component as outcome of the DEMATEL technique. An approximation method in which Δk is changing in steps say 0.01 until the ranking of alternatives is reversed. In this research the following steps are taken to find out the criticality degree of C_{64}.

Step 1:

All the original weights of the criteria are written in the following Table 4.79.

Step 2:

Now the weight of C_{64} is reduced in a small step of 0.01 as per Eq19. The weight of C_{64} is reduced by 0.01, the new weight becomes 0.024007 and the weights of all other criteria are also normalized by dividing it with 0.99 (sum of weights of all criteria except C_{64} and criterion C_{64}). The weights of all other criteria are normalized with the help of the formula in Eq 20 and are displayed in the following Table 4.80. In Table 4.80, A1 is used for first alternative. A2 is used for second alternative and A3 is used for third alternative.

Step 3:

The new normalized weights are once again multiplied with the normalized performance matrix and the results are displayed in the following Table 4.81.

Table 4.79 Original Weights

Weights	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	0.032132	**0.033767**	**0.023162**	**0.032025**	**0.035692**	**0.032025**	**0.032132**	**0.032025**	**0.023164**	**0.035487**	**0.035538**	**0.023162**	**0.023162**	**0.032025**	**0.023162**	**0.033766**	**0.032025**
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{65}	C_{64}	
	0.033767	**0.023162**	**0.035487**	**0.021117**	**0.023162**	**0.032025**	**0.032025**	**0.035538**	**0.032025**	**0.035538**	**0.035692**	**0.030862**	**0.023162**	**0.023162**	**0.035056**	**0.033767**	

Table 4.80 New weights

New weights	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	0.032457	**0.034108**	**0.023396**	**0.032349**	**0.036052**	**0.032349**	**0.032457**	**0.032349**	**0.023398**	**0.035846**	**0.035897**	**0.023396**	**0.023396**	**0.032349**	**0.023396**	**0.034107**	**0.032349**
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{65}	C_{64}	
	0.034108	**0.023396**	**0.035845**	**0.02133**	**0.023396**	**0.032349**	**0.032349**	**0.035897**	**0.032349**	**0.035897**	**0.036052**	**0.031173**	**0.023396**	**0.023396**	**0.035411**	**0.024007**	

Table 4.81 Final Matrix Multiplied with Normalized Parameters

Alternatives	C_{11}(+)	C_{12} +)	C_{13}(+)	C_{14}(+)	C_{15}(+)	C_{16}(+)	C_{17}(+)	C_{21}(+)	C_{22}(+)	C_{23}(+)	C_{24}(+)	C_{25}(+)	C_{26}(+)	C_{27}(+)	C_{28}(+)	C_{31}(+)	C_{32}(+)
A1	0.015957	0.020938	0.013699	0.018921	0.018232	0.018887	0.021823	0.018941	0.01561	0.017562	0.018073	0.013677	0.014813	0.019129	0.013338	0.021936	0.017243
A2	0.017514	0.019416	0.013699	0.018921	0.021038	0.018887	0.017667	0.018135	0.012324	0.020551	0.021149	0.013162	0.012805	0.017738	0.013338	0.019151	0.019354
A3	0.022183	0.018654	0.013116	0.018179	0.022908	0.018247	0.016281	0.018941	0.012324	0.02354	0.022686	0.013677	0.012805	0.019129	0.013841	0.017758	0.019354

Alternatives	C_{33}(+)	C_{34}(+)	C_{35}(+)	C_{41}(+)	C_{42}(+)	C_{43}(+)	C_{44}(-)	C_{45}(+)	C_{51}(-)	C_{52}(-)	C_{53}(+)	C_{61}(+)	C_{62}(-)	C_{63}(-)	C_{65}(+)	C_{64}(+)
A1	0.02085	0.013203	0.022064	0.011485	0.012918	0.017243	0.017804	0.02095	0.019071	0.022686	0.021001	0.019835	0.013677	0.013174	0.022774	0.015389
A2	0.019437	0.014098	0.020664	0.012951	0.013793	0.019354	0.019098	0.021685	0.019071	0.021149	0.022424	0.017317	0.013677	0.013671	0.019883	0.014412
A3	0.01873	0.013203	0.019263	0.012463	0.013793	0.019354	0.019098	0.01948	0.017861	0.018073	0.018865	0.016687	0.013162	0.013671	0.018437	0.011481

Step 4:

All the values of benefit criteria (the criteria which are represented by (+)) are calculated. All the values of cost criteria (the criteria which are represented by (-)) are calculated. The final rankings displayed in the following Table 4.82 were deduced by subtracting the sum of cost criteria (denoted by (–) sign) from the sum of benefit criteria (denoted by (+) sign) for all the alternatives.

Table 4.82 Final Output

Alternatives	Sum of benefit criteria	Sum of cost criteria	Net value Rank
Quality development initiative at individual level (A1)	0.479249	0.086413	0.392836(Rank1)
Quality development initiative at the organizational level(A2)	0.471513	0.086667	0.384846(Rank2)
Quality development initiative with the integration of external stakeholders(A3)	0.466028	0.081865	0.384164(Rank3)

The outcome of net value from Table 4.82 clearly indicates that there is no change in the new ranking of the alternatives. Therefore, the previously taken steps need to be repeated once again. This time the original weight of criterion is reduced by 0.02. The same steps are once again repeated as per Eq 19, Eq 20, and Eq 21. The results are displayed in following Tables: Table 4.83, Table 4.84, and Table 4.85.

Table 4.83 Original Weights Table

Weights$_{sj}$	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	0.032132	0.033767	0.023162	0.032025	0.035692	0.032025	0.032132	0.032025	0.023164	0.035487	0.035538	0.023162	0.023162	0.032025	0.023162	0.033766	0.032025
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{65}	C_{64}	
	0.033767	0.023162	0.035487	0.021117	0.023162	0.032025	0.032025	0.035538	0.032025	0.035538	0.035692	0.030862	0.023162	0.023162	0.035056	0.033767	

4.84 New Weights by Reducing Weight of C_{64} by 0.02

New Wj	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{31}	C_{32}
	0.032788	0.034456	0.023635	0.032679	0.03642	0.032679	0.032788	0.032679	0.023637	0.036211	0.036263	0.023635	0.023635	0.032679	0.023635	0.034455	0.032679
	C_{33}	C_{34}	C_{35}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{63}	C_{65}	C_{64}	
	0.034456	0.023635	0.036211	0.021548	0.02363	0.032679	0.032679	0.036263	0.032679	0.036263	0.03642	0.031492	0.023635	0.023635	0.035772	0.014048	

Table 4.85 Resultant of Weights Multiplied with Normalized Parameters

Alternatives	C_{11}(+)	C_{12} +)	C_{13}(+)	C_{14}(+)	C_{15}(+)	C_{16}(+)	C_{17}(+)	C_{21}(+)	C_{22}(+)	C_{23}(+)	C_{24}(+)	C_{25}(+)	C_{26}(+)	C_{27}(+)	C_{28}(+)	C_{31}(+)	C_{32}(+)
A1	0.016120	0.021152	0.013839	0.019114	0.018418	0.019080	0.022046	0.019135	0.015770	0.017741	0.018257	0.013817	0.014964	0.019324	0.013474	0.022159	0.017419
A2	0.017693	0.019614	0.013839	0.019114	0.021253	0.019080	0.017847	0.018320	0.012450	0.020761	0.021365	0.013296	0.012936	0.017919	0.013474	0.019346	0.019551
A3	0.022410	0.018845	0.013250	0.018364	0.023142	0.018433	0.016448	0.019135	0.012450	0.023780	0.022918	0.013817	0.012936	0.019324	0.013982	0.017940	0.019551

Alternatives	C_{33}(+)	C_{34}(+)	C_{35}(+)	C_{41}(+)	C_{42}(+)	C_{43}(+)	C_{44}(-)	C_{45}(+)	C_{51}(-)	C_{52}(-)	C_{53}(+)	C_{61}(+)	C_{62}(-)	C_{63}(-)	C_{65}(+)	C_{64}(+)
A1	0.021063	0.013338	0.022290	0.011603	0.013049	0.017419	0.017985	0.021164	0.019266	0.022918	0.021215	0.020038	0.013817	0.013309	0.023007	0.009005
A2	0.019636	0.014242	0.020875	0.013084	0.013934	0.019551	0.019293	0.021906	0.019266	0.021365	0.022653	0.017494	0.013817	0.013811	0.020086	0.008433
A3	0.018921	0.013338	0.019460	0.012590	0.013934	0.019551	0.019293	0.019679	0.018043	0.018257	0.019058	0.016858	0.013296	0.013811	0.018625	0.006718

Step 4:

The final rankings displayed in the following Table 4.86 are deduced by subtracting the sum of cost criteria (denoted by (–) sign) from the sum of the benefit criteria (denoted by (+) sign) for all the alternatives from the previous Table 4.85.

Table 4.86 Final Output

Alternatives	Sum of benefit criteria	Sum of cost criteria	Net value Rank(Change in Ranking)
QDI at individual level (A1)	0.477598	0.087295	0.390304(**Rank1)**
QDI at the organizational level(A2)	0.470198	0.087551	0.382647(**Rank3)**
QDI with the integration of external stakeholders(A3)	0.465904	0.0827	0.383204**(Rank2)**

The outcome of net value from Table 4.86 clearly indicates that there is change in the ranking. The rank2 is given to A3 and rank3 is given to A2.The criticality degree of criterion C_{64}= smallest possible % of change in the weight of criterion which brings the change in the rankings. By reducing the original weight (0. 0.033767) of C_{64} is reduced by 0.02, the new weight of criterion becomes 0.014048.The percentage change is given by the calculations, [(0.014048 -0.033767) / 0.033767]* 100 which is numerically equal to (-58.3972%). The (–) sign indicates the decrease in the value.

D_{64} = 58.3972%

The sensitivity coefficient of criterion C_{64}, Sens (C_{64}) = 1/ 0.583972= 1.72

This result indicates that the original ranking in the assessment model is really meaningful, and it is making the assessment system very robust. Hence it validates the order of ranking. So according to this result, this sensitivity analysis ends with the assurance that the present system of ranking is quite robust and institutions can implement such initiatives in the BLE without any doubt. Next, a brief on the development of framework is explained in next section.

4.7 Brief on Development of Framework

The framework is taking the shape with the end of the Sensitivity Analysis. The framework is going to join the result of Learners responses (through the use of Exploratory Factor Analysis) with the result of Faculty's responses (through the application of the DEMATEL method).Afterwards, the combined result is applied on the external stakeholders responses (through the use of the MOORA method).The alternatives of management strategy are written in terms of quality development. The result indicates the prioritization by ranking the alternatives. This whole structure is represented in the next chapter. A further attempt will be to optimize the framework by applying the EFQM method on only cause criteria (through the application of the RADAR approach) so that the institutions can do self-assessment by adopting it.

4.8 Summary

This chapter is covering all analytical methods in order to develop an assessment framework in the TQM perspective. The results of all these analytical techniques (Basic analysis, Exploratory Factor analysis, DEMATEL technique, MOORA technique and Sensitivity analysis) have helped in the development of an assessment framework for the BLE in higher education sector. This is an attempt to introduce more objectivism in the subjective nature of quality.

The next chapter details the formulated framework. The TQM based method (EFQM excellence model) will be used in order to assess the causing criteria only which is an ideal way to bring excellence in the BLE because the quality of effect criteria will automatically improve as it is totally dependent upon the quality of cause criteria. The results of the DEMATEL and the MOORA method are combined together (only for the group of cause criteria).The EFQM method will be applied on the combined result which will further help the institutions to do self-assessment. The next chapter is explaining it in a detailed way.

Chapter 5: Framework

5.1 Introduction

The use of analytical techniques in this study has offered a framework to attain superior quality learning environment in the field of higher education. A thorough review of literature on blended learning, TQM, and other related assessment models has revealed a set of 33 variables under six main factors which are important for the quality related activities happening in pedagogical, social, technological, organizational, and evaluation and assessment components of the BLE.

5.2 Development of Framework

This framework in Figure 5.1 is an attempt to combine the findings of literature review, interviews, adopted analytical methods and, TQM assessment techniques to provide the superior quality BLE. Initially, the different 33 variables under five dimensions: pedagogical, social, technological, organizational, and evaluation and assessment (obtained through literature review and interviews) are used to design the questionnaire instrument. This questionnaire is given to learners to get the first hand information. The learners are the main stakeholders. Hence the responses of learners play the most significant role in the formation of framework. The responses are analyzed with the help of exploratory factor analysis. This factor analysis has divided all the initial variables of questionnaire into 6 main factors. The 6 factors (F1, F2, F3, F4, F5 and F6) and underlying 33 criteria (C_{11} to C_{17}, C_{21} to C_{28}, C_{31} to C_{35}, C_{41} to C_{45}, C_{51} to C_{53} and C_{61} to C_{65}).The results of this analysis are clearly displayed in Figure 5.1.

Next, the results of the exploratory factor analysis are discussed with the faculty members. The DEMATEL technique is applied on faculty responses. This method divides the factors and criteria into the cause group (cause factors and cause criteria) and effect group (effect factors and effect criteria). The DEMATEL technique is also used to find out the most influenced, the most impacted, and the most related (factor and criterion) respectively. This division helps the decision makers to pay more attention to the factors and criteria which are under the cause group because the factors and criteria which are under the effect group are getting the effect from the cause group only.

The factors in the cause group are: Technical and technological competence (F3) and Effective communication and interaction competence (F5). The criteria in the cause group are written in the descending order of their prominence: Qualification and experience of tutor, A well explained content, Prior knowledge of computers, Lack of sufficient funds and resources, A well-defined course structure, Support of tutor, Problem based learning , Right blend of f2f and online learning activities , Face-to-Face discussion of student’s performance, Ease of use of learning management system, Provision of adequate (synchronous and asynchronous) facility, Formal and informal kind of assessment, Modernized technology equipped infrastructure, Resistance to embrace change by stakeholders, Personalization of course content and course structure, Availability of communication services (24/7), Lack of communication, and lastly Clearly defined policies and procedures.

The most prominent criterion C_{64} out of all these criteria is the “Qualification and experience of tutor”. This criterion is the master influencer .The most related criterion is the “Appropriate use of delivery methods”. All these results can help the decision maker from the top management to take the right action in dealing with these results. The design and implementation of the quality strategy must embed all these parameters carefully. The Table 5.1 shows the criterion values from their highest value of influence to the lowest value of influence. The criterion C_{64} “Qualification and experience of tutor” has the highest influence on the other criteria and C_{43} “Clearly defined policies and procedures” has the lowest influence in the cause group.

In real life situation, the institutions can opt to focus on only cause criteria because if institutions can optimize the quality dimension of all cause criteria, then the effect criteria quality will be optimized automatically without any extra effort. The Table 5.1can be thoughtfully considered in implementing the quality development initiatives by the top management.

Table 5.1 Level of Influence from highest to lowest value

Positive values of (D – R) form Cause group	Level of Influence from highest to lowest value
2.837688225(**highest influence)**	C_{64} - Qualification and experience of tutor
2.777869036	C_{65}- A well explained content
2.034651596	C_{23}- Strong leadership
1.208448916	C_{61}- Prior knowledge of computers
1.090748262	C_{62} -Lack of sufficient funds and resources
1.067042639	C_{12}-Well defined course structure
1.044303053	C_{15} -Support of tutor
0.830055643	C_{11} -Problem based learning
0.758450005	C_{13}- Right blend of f2f and online learning activities
0.475032039	C_{26} -F2f discussion of student's performance
0.462476284	C_{34} -Ease of use of learning management system
0.432574984	C_{31} -Provision of adequate (synchronous and asynchronous) facility
0.261657674	C_{25}- Formal and informal kind of assessment
0.258379153	C_{32}- Modernized technology equipped infrastructure
0.246752904	C_{63}- Resistance to embrace change by stakeholders
0.21211506	C_{17}- Personalization of course content and course structure
0.115996624	C_{33}- Availability of communication services (24 x 7)
0.083403822	C_{51}- Lack of communication
0.019197819 (**Lowest Influence)**	C_{43}- Clearly defined policies and procedures

Table 5.2 Negative values of (*D*-*R*) from the effect group

Negative values of ($D - R$) from Effect group	Level of Influence from highest to lowest value
-0.080198511**(Highest Influence)**	C_{35} An adequate online support system
-0.110324804	C_{14} Appropriate use of delivery methods
-0.163759146	C_{52} Feeling of isolation
-0.293307869	C_{24} Evaluation by international standards
-0.318595298	C_{16} Prompt and continuous feedback
-0.498136997	C_{53} Effectiveness of interactions
-0.873212434	C_{22} Self-assessment
-1.244212169	C_{45} Improvement of retention rate
-1.273204735	C_{42} Awarding an authoritative degree
-1.936526623	C_{28}Social and Networking feature
-2.204753507	C_{21} Return on investments
-2.270533498	C_{44}Reduction of carbon emission
-2.461364976	C_{27} Sustainability feature
-2.488713171(**Lowest Influence)**	C_{41} Collaboration with international universities

In Table 5.2, the effect group criteria are listed as: An adequate online support system, Appropriate use of delivery methods, Feeling of isolation, Evaluation by international standards, Prompt and continuous feedback, Effectiveness of interactions, Self-assessment, Improvement of retention rate, Awarding an authoritative degree, Social and Networking feature, Return on investment, Reduction of carbon emission, Sustainability feature, and Collaboration with international universities.

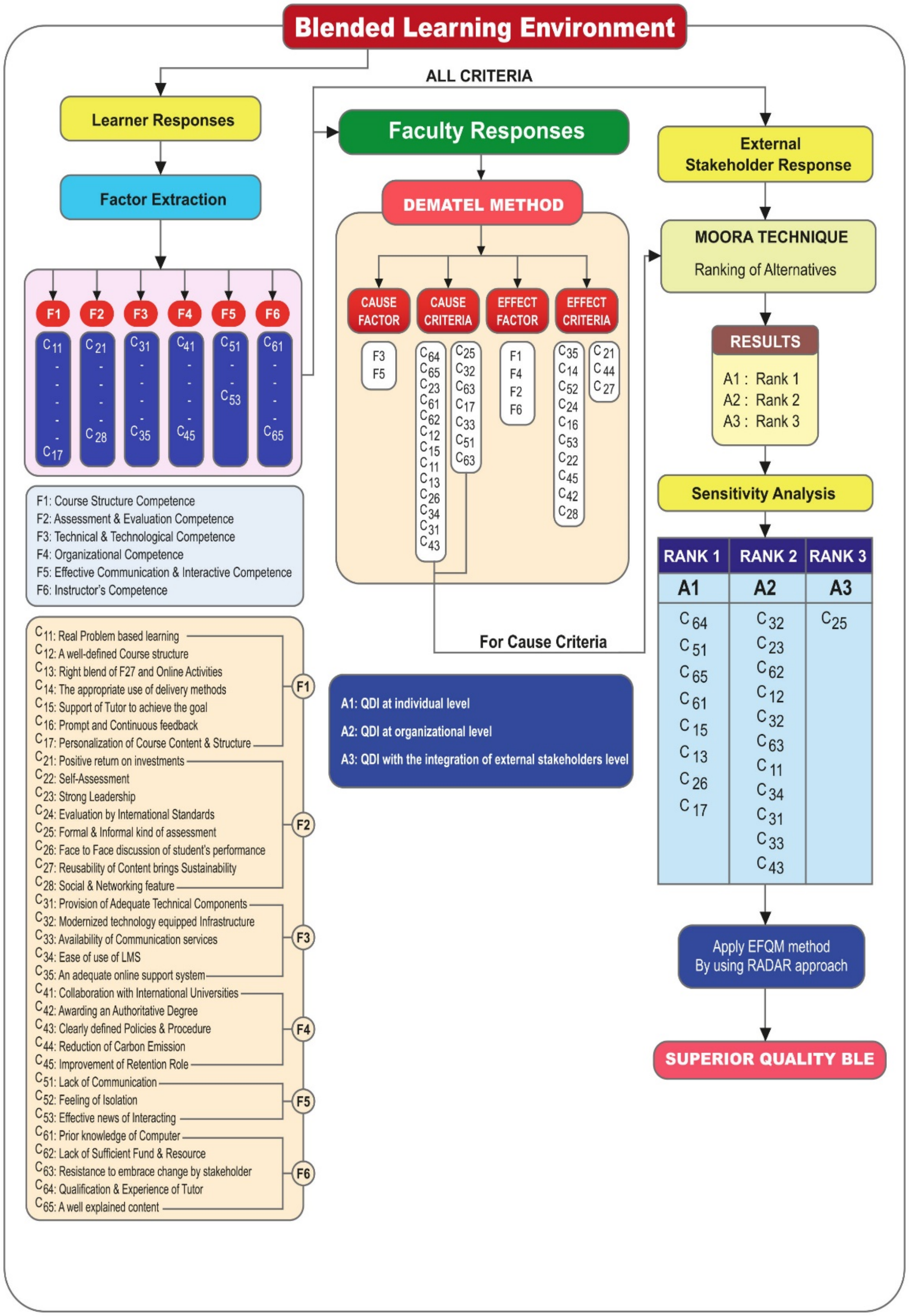
Next, the MOORA method is applied on all criteria. The rationale for using the MOORA method is to use multi objective optimization method to prioritize the quality development initiatives. From the work of researcher Stracke (2010) in quality, it was quite evident that the quality development initiatives need to be implemented at three levels to support the idea of developing the quality culture companywide. The MOORA method gives ranking to these alternatives: QDI at the individual level (Rank1), QDI at the organizational level (Rank2), and QDI with the integration at the external stakeholders' level (Rank3).This ranking helps the decision makers at the top management level to introduce this result as a part of management strategy.

Moreover, the use of the MOORA technique on the cause criteria only provides the ranking to the alternatives: A1, A2, and A3. The result is: Rank1 to A1, Rank2 to A2 and Rank3 to A3.The Figure 5.1 shows this result.

In addition, the other fact can be concluded that in reality if the institutions only take into account the cause group criteria in prioritization of quality development initiatives, then it will lead to not only saving of big amount of efforts but also will result in achieving more output, more satisfaction, and saving of a lot of time and resources. The savings can be invested also in improving quality.

The top management has to be motivated to take proper actions in the development of quality culture in the institution. A proper strategy needs to be carefully designed which entails the result of prioritization of cause criteria. The adoption of this kind of strategy can lead to not only savings of big amount of efforts, time and resources but also will result in achieving more output and satisfaction. In the next subsection, the results of DEMATEL and MOORA are combined together with the help of quality expert.

Figure 5.1: Framework



5.2.1 Combining the Results of DEMATEL and MOORA in Framework

The DEMATEL technique resulted in dividing the quality criteria of the blended learning environment in the cause and effect criteria. The MOORA technique has helped in ranking the levels of quality development implementation initiatives: at the individual level (Rank1), at the organizational level (Rank2) and, at the external stakeholder level (Rank3). Afterwards, the results of the DEMATEL and the MOORA method are combined by separating the cause criteria under three alternatives as shown in the following Table 5.3 and displayed in Figure 5.1.

Table 5.3 Combining the Results of the DEMATEL and MOORA Method

Quality development initiative at individual level (**Rank1)**	Quality development initiative at organizational level **(Rank2)**	Quality development initiative by integrating external stakeholder (employer, technology suppliers, social and environment activists, government and industry representatives) level **(Rank3)**
C_{64} Qualification and experience of tutor	C_{32} Modernized technology equipped infrastructure	C_{25} Formal and informal kind of assessment
C_{51}Lack of communication	C_{23} Strong leadership	
C_{65} A well explained content	C_{62} Lack of sufficient funds and resources	
C_{61} Prior knowledge of computers	C_{12}Well defined course structure	
C_{15} Support of tutor	C_{32} Modernized technology equipped infrastructure	
C_{13} Right blend of f2f and online learning activities	C_{63} Resistance to embrace change by stakeholders	
C_{26} F2f discussion of student's performance	C_{11} Problem based learning	
C_{17} Personalization of course content and course structure	C_{34} Ease of use of learning management system	
	C_{31} Provision of adequate (synchronous and asynchronous) facility	
	C_{33} Provision of communication services (24 / 7)	
	C_{43} Clearly defined policies and procedures	

The implication of this result is that the educational institutions can use a logical approach in achieving excellence in the quality development of the BLE. This logical approach results in saving not only lot of efforts, time, and money for institution but also help in bringing excellence in the quality development and assessment activity because the institution is aware of the fact that what level of priority should be given to different cause criteria.

Now, in the last stage, The TQM assessment model, EFQM is applied on the cause criteria to assess the quality of BLE. This application results in to superior quality BLE which is the final result of this research (see Figure 5.1).

The full application of EFQM excellence model on the combined results of DEMATEL and MOORA is explained very clearly in the next section.

5.3 Application of EFQM model on the combined result of DEMATEL and MOORA

All the cause group criteria can be divided into five enablers of EFQM. These five enabler criteria of EFQM are: leadership, people, policy and strategy, partnership and resources, and processes. These are shown in following Table 5.4.

Table 5.4 Division of Cause Criteria under EFQM Enablers

C_{23} Strong leadership(leadership)
C_{61} Prior knowledge of computers(People)
C_{64}Qualification and experience of Tutor(People)
C_{15} Support of tutor(People)
C_{32}Modernised technology equipped infrastructure(resource)
C_{51} Lack of Communication(process)
C_{13} Right blend of f2f and online learning activities(process)
C_{63} Resistance to embrace change by stakeholders(process)
C43 Clearly defined policies and procedures(resource)
C_{26} F2f discussion of student's performance (process)
C_{17} Personalization of course content and course structure(process)
C_{11} Problem based learning(resource)
C_{62} Lack of sufficient funds and resources(resources)
C_{12}Well defined course structure(resource)
C_{34} Ease of use of learning management system (resource)
C_{65} A well explained content(resource)
C_{31} Provision of adequate (synchronous and asynchronous) facility(resource)
C_{33} Availability of communication services (24 x 7)(resource)
C_{43} Clearly defined policies and procedures(policy)
C_{25} Formal and informal kind of assessment(strategy)

In Table 5.4, all cause criteria are divided into fine main enablers of the EFQM model: leadership, people, policy and strategy, partnership and resources, and processes. The criteria under leadership enabler are: strong leadership.

Similarly, the criteria under people enabler criterion are: Prior knowledge of computers and Support of tutor.

The criteria under policy and strategy enabler criterion are: Clearly defined policies and procedures and Formal and informal kind of assessment.

The criteria under resource and partnership criterion are: Problem based learning, Lack of sufficient funds and resources, Ease of use of learning management system, Well defined course structure, A well explained content, Provision of adequate (synchronous and asynchronous) facility, and Availability of communication services (24/7).

Lastly, the criteria under process enabler criterion are: Right blend of f2f and online learning activities, Resistance to embrace change by stakeholders, and Lack of communication. In the next section, the RADAR method is used for applying EFQM method.

5.4 Application of EFQM model

The whole RADAR approach is shown for all cause criteria in Table 5.5.

Table 5.5 RADAR Approach

(Cause) Criterion	**What should criterion contribute as results(RESULT)**	**How to achieve criterion 's effectiveness (Approach)**	**How to Deploy this criterion(DEPLOY)**	**How to achieve criterion's assessment(Assessment)**	**How to achieve criterion's refinement (Refinement)**
1. Prior knowledge of computers	a. Satisfied learners in the learning Environment b. Proficient use of computers	a. Make Effective use of computers in the blended learning activities b. Learners are benefitted with this knowledge	a. By arranging trainings before the start of the course to build up the minimum level of computer knowledge	a. Learner can be asked to submit a document before starting a course indicating that he/she has prior knowledge of computer b. During staffing of faculty members and staff	a. By conducting one assessment before the start of the course to find out the average level of computer knowledge b. Provision of online trainings to the registered learners c. Provision of recorded trainings d. Implementing a strategy in which faculty members are sharing their prior knowledge of computers with other learners and colleagues during the induction program e. Providing help desk
2.Personalization of course content	a. Satisfied ,more independent and knowledgeable learner b. Learners are benefitted with this personalized knowledge	a. Continuous facilitation from faculty to improve learner's skills and satisfaction level b. Provision of content as per the needs and	a. Providing the list of learners with different learning styles to faculty members before the start of course	a. By checking the availability of number and kind of resources on the same content by HOD or subject heads	a. Appropriate training to HOD subject heads, faculty members and staff to enhance skills for personalization of course content and structure b. learners are being informed through different ways to

	c. Special need learners are benefitted by this attempt.	requirements of learner c. By keeping a track of all learners 's results	b. Providing latest kind of trainings and resources to faculty members to keep them equipped with new innovations c. Providing special time to faculty members in their schedule to work collaboratively and share their knowledge for the development of these resources.	b. By taking feedback from the learners on their satisfaction levels from the existing use of personalization of course content	make use of facility of personalization of course content c. By doing collaboration with the partner colleges or use free online resources to add resources in resource repository and make an effort to personalize course content
3. Support of tutor	a. Satisfied and contented learners b. Continuous improvement in the learner's performance	a. Provision of online support as well as f2f support as per the strategy of institution and requirements of learner b. Clarification on the role of tutor during the induction program to both learners and faculty members. c. Proper trainings to use effectively the teaching resources through latest technology and tools d. Tutor is rewarded for dedicated work	a. By explaining clearly the role of tutor in the handbook of organization b. By giving feedback to tutor (learners opinion) time to time during the course so that he/she can improve his/her efforts to provide support as per learner c. Provision of sending online	a. Learner's satisfaction b. Provision of support as per the strategy of institution and requirements of learner c. Change in Learner's results and performance after support.	a. Right planning and managing, to appoint an is required to appoint right tutor, appropriate number of hours and expert (number of hours) b. Provision of the right kind of technology and resources. c. Provision of more than one online tutor for some difficult courses. d. Provision of expected competence level of tutor from the institution

			comments to learner		
4. Lack of communicatio n	a. Poor learning b. Dissatisfaction in learners and employees c. Learner's bad results or poor performance	a. Providing Proper trainings to emphasize the importance of effective communication b. Providing Proper trainings to emphasize the use of effective communication tools	a. By taking feedback from learners and faculty members b. Providing support to overcome this limitation of learners and faculty members	a. Dissatisfaction in the learning environment b. In efficient use of technology and tools c. Non availability of appropriate trainings on the effective use of communication facilities and tools	a. Proper trainings needs to be conducted for all (learners, faculty and teaching staff) b. Provision of updated version of related software and tools. c. Immediate services are available in case help is required to use communication tools effectively.
5. Face to face discussion of student's performance	a. Improved performance and results b. Contented , well informed and confident learner	a. Provision of immediate F2F discussion of student's performance(if needed) must be in institution's strategy which means either online or physical face-to-face discussion	a. Availability of an easy and known method for faculty members to conduct either online or physical face to face discussion as per the need and access of learner	a. High satisfaction level b. Improved student's performance c. The use of right tool of communication which means either physical face to face or use of available tools for synchronous communication	a. This activity needs to be systematically designed and managed. b. This activity needs to be delivered by keeping learner's personal details in mind. c. Learner must be conveyed very clearly about the performance indicators
6. A well explained content	a. Confident and satisfied learners b. Learners are able to explain it to other learners c. Learners are able to apply knowledge	a. The faculty members should get it checked through subject experts before explaining either online or offline	a. Make the recordings of the content and provide it online so that learners can avail it as per their	a. Learner 's satisfaction and results b. Attendance for lectures c. Explanation of content using variety	a. Collaboration with other universities as a policy or through partnership for teaching same content b. Involvement in the projects where learned knowledge can be applied in reality.

	in real world situations.	b. Attendance of learners for lectures should be a criteria to continuously check the quality of content. c. Explanation of content using all learning styles in mind.	convenience and flexibility	of real time situations d. Content is produced, delivered and managed carefully e .The number of times the learner have logged in for some particular content	
7. Qualification and Experience of tutor	a. Learner's good results b. High satisfaction rate of learner c. High retention rate in course	a. To check these parameters :Qualification and Experience of tutor before appointment b. To check these parameters :Qualification and Experience of tutor through the kind of research and projects , they are involved in.	a. Providing the introduction of qualification and experience of tutor on institution's web page b. Requesting the faculty members to demonstrate their qualification and experience through real time activities	a. Learner's satisfaction and results b. The introduction of innovative tools and techniques	a. Faculty members are motivated to be involved in the research activities and trainings programs b. Collaboration with other faculty members during seminars and conferences to learn new effective ways of teaching
8. Problem based learning	a. Providing more depth knowledge of the content to learner b. More engagement by connecting with real world problems c. Learning by doing in problem based learning bring	a. Introduction of learning by doing concept in curriculum b. More involvement with industry and society related projects which a learner can relate with. c. Frequent use of industrial site visits	a. To provide more opportunities to work while studying. b. By involving them in group work and projects for Effective learning through the use of modernized	a. More confident learners b. More placements from campus c. Happy employers d. More renowned institution e. More effective and deep learning for life long	a. Institution must make an effort to engage learners in learning one of the skills of their choice mandatory so that they learn to think analytically b. More encouragement to make curriculum related to problem based learning

	patience, confidence and work like simulation which help them to become independent and decisive in his/her choices	either online or in person d. More time needs to be given in curriculum to involve students in industry and society related activities to get experience of real world problems while working	technology equipped infrastructure and resources		c. Making compulsory to teach the learned skills to the other learners by every learner
9.Ease of use of LMS (learning management system)	a. More flexibility to learners b. Extensive use of LMS by learners and faculty members during course c. Effective way of assessing learner's results d. Effective learning through the use of problem based learning. e. Effective use of e-services and e-library through LMS	a. To make it easy to use for Learners and faculty through frequent and effective trainings. b. To make it mandatory to use this tool in learning and teaching activities.	a. By keeping a check on its use initially before making it as routine of using it for all learning and teaching activities	a. Learners and faculty members are using it extensively and effectively b. Most of the blended learning activities require the frequent use of LMS in learning environment c. Learners feel comfortable and give no excuses in using LMS. d. Extensive use of e-services and e-library through LMS	a. Continuous trainings so that everyone in the learning environment feels comfortable to use it b. Incorporation of latest updates in LMS technology
10. Provision of adequate synchronous and asynchronous facility	a. Learners and faculty members are using it effectively b. Most of the blended learning activities require	a. An easy access of use of synchronous and asynchronous tools I the learning environment b. An arrangement with the companies	a. The top management of the institution must make an effort so that the awareness is made at all levels of	a. Extensive use of synchronous and asynchronous tools by learners and faculty members b. Most of the blended learning	a. More frequent trainings on their effective use b. Incorporation of latest updates in synchronous and asynchronous tools by the top IT companies like Microsoft.

	the frequent use of synchronous and asynchronous tools in learning environment c. Learners feel comfortable in using adequate synchronous and asynchronous tools d. Learners feel autonomous in selecting the tool of their choice	like Microsoft to keep updated the learning environment with latest innovations in the field of synchronous and asynchronous tools	institution about the provision of adequate synchronous and asynchronous tools	activities in the course curriculum require the frequent use of synchronous and asynchronous tools in learning environment c. By checking learners reaction that whether they feel comfortable in using synchronous and asynchronous tools	
11. Availability of communication services	a. More flexibility and mobility for learners b. Improved performance of learners	a. To provide the latest technology of communication services b. Proper trainings so that communication services can be used effectively	a. To communicate effectively in the organization for the availability of communication services through 24/7 broadband b. Frequent reminders (online or f2f) of the latest updates in the communication services	a. More satisfied and autonomous learner b. Extensive use of blended learning activities in the course curriculum via 24/7 communication services	a. Management needs to implement this service effectively so that learners are benefitted optimally b. Collaboration with other universities c. Collaboration of leadership teams with employers to get a picture of future requirements
12. Modernized technology enhanced infrastructure	a. More choices to learner b. More renowned institution c. Effective learning through the use of	a. The government and top management people need to be convinced to provide latest technology equipped modernized	a. By arranging funds from government and parents	a. Effective use by learners and faculty members b. Extensive use of blended learning activities which	a. Continuous maintenance of modernized technology equipped infrastructure b. Incorporation of continuous improvements and innovations in

	modernized technology equipped infrastructure	infrastructure to make learning experience delightful		require modernized technology equipped infrastructure in learning environment c. Delightful learners who feel proud to study in modernized technology equipped infrastructure	modernized technology equipped infrastructure
13. Clearly defined policies and procedures	a. Clearly defined policies in an official document as per the needs and expectations of both internal and external stakeholder b. High satisfaction rate c. Understanding of internal performance and capabilities of institution	a. Using the available benchmarks in defining the policies and procedures clearly b. Taking feedback from time to time to make changes in their clarity and usefulness. c. Policies need to be communicated and deployed carefully through plans, processes and objectives	a. Provision of e - book or physical handbook which defines in a clear way the policies and procedure.	a. Satisfaction in the learning environment among learners and employees. b. Provision of e-book or physical handbook which defines in a clear way the policies and procedures	a. Policies and procedures are developed, reviewed and updated to ensure economic, societal and ecological sustainability b. Policies and procedures need to be updated and reviewed on regular basis c. Policies and procedures need to be deployed carefully through a framework of key processes
14. Resistance to embrace change by stakeholders	a. Feel uncomfortable in using technology and technological tool like LMS b. Poor performance and results	a. To motivate and support learners with reasoning in accepting changes with less resistance	a. By communicating the positive and welcoming consequences of embracing change	a. Number of pending decisions b. Dissatisfaction in the learning environment c. Learners feel comfortable in using	a. More frequent communication on the positive effects of embracing change b. A positive explanation and training with reasoning to embrace change

				synchronous and asynchronous tools	
15. Strong Leadership	a. Motivation and satisfaction in the working environment b. Continuous improvement in the learning environment c. Institution is associated with high rate of employment and retention	a. The careful selection of leadership team b. Enforcing a strategy of institution which promotes trainings and collaborative activities for leadership team	a. By trusting the leadership team and following its decisions by full commitment.	a. Leaders are developing the mission, vision & values and they are role models of a culture of excellence in the learning environment b. Leaders are personally involved in ensuring the quality of learning environment c. Leaders are enthusiastic to develop, implement & continuously improve the system to bring contentment in the learning environment d. Leaders are involved with learners , faculty , department heads ,partners & representatives of society e. Leaders motivate, support & recognize	a. Trainings to leadership team on TQM techniques like six sigma and EFQM etc. b. Collaboration with leadership teams of other universities c. Collaboration of leadership teams with employers to get a picture of future requirements

				the organization's people	
16. Formal and Informal kind of assessment	a. More confident learner b. Improved performance of learner c. More choices and flexibility for faculty members.	a. To promote all kind of assessment (formal and informal kind of assessment) in BLE through the use of technology b. To promote faculty members to evolve new innovative ways of conducting formal and informal kind of assessment.	a. Most Latest kind of trainings to faculty members to design meaningful assessments for online and f2f modules b. The welcoming nature of management to promote new innovations in assessments c. Taking learners, and employers opinion also in designing the assessment **<u>new</u> :** To design carefully the assessments in accordance to different levels of mastery of learners	a. More smart and knowledgeable learner b. More options for faculty and subject leaders	a. Management needs to spend lavishly in giving training to faculty members to create effective assessments b. Collaboration with faculty members of other universities which help in bringing fresh ideas related to assessment

17.Well defined course structure	a. Clearly defined course structure in an official document as per the demand of course content b. Designing the course structure as per the future demands of employers and using resources of institution optimally	a. Using the available benchmarks in designing the course structure b. Taking feedback from time to time from industry representatives to make changes in the course content c. Before designing, the future needs of employers need to be communicated carefully	a. Provision of e - book and physical handbook which defines in a clear way the course outline, number of hours assigned, number of credit given and lastly the different modes of conducting assessments	a. Satisfaction in the learning environment among learners and faculty members b. High demand of particular course in an institution	a. Mode of delivering course content can be reviewed and updated time to time to bring more practical aspect in defining and delivering the course structure
18. Right blend of f2f and online learning activities	a. Providing more depth knowledge of the content to learner by providing thoughtful blend of f2f and online learning activities b. More engagement by connecting with different modes of learning c. Deep and independent learning	a. Introduction of right blend of f2f and online learning activities b. More time needs to be given in curriculum and course structure designing to involve thoughtful blend of f2f and online learning activities	a. To provide learners full course content with right blend of f2f and online learning activities	a. More confident learners b. More effective and deep learning for life long	a. Institution must make an effort to engage learners with right blend of f2f and online learning activities

19.Lack of sufficient funds and resources	a. Poor learning b. Dissatisfaction in learners and employees c. Learner's bad results or poor performance	a. Providing Proper trainings to utilize the available resources effectively b. Providing required resources and funds by management on time	a. By taking feedback from learners and faculty members the areas, in which more funds and resources are required	a. Dissatisfaction in the learning environment b. Inefficient use of technology and tools	a. Proper trainings needs to be conducted for all (learners, faculty and teaching staff) to use the available funds and resources effectively

Table 5.5 has described the RADAR approach under the EFQM method for application on all cause criteria. The entries in five columns give a brief description of five parameters: results, approach, deployment, assessment and refinement of all cause group criteria. The points in each column are highlighted as per the researcher's knowledge, experience, and related literature review.

The first criterion is: Prior knowledge of computers. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this effectiveness can be brought to the criterion: prior knowledge of computers. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column entries indicate the steps to assess this criterion so that the desired results can be achieved. The last column entries indicate the suggestions to refine this criterion in future.

The second criterion is: Personalization of course content. The second column entries related to this criterion indicate what this criterion contributes as results. Some suggestions are highlighted in this column. The third column entries indicate the approach so that this kind of effectiveness can be brought to the criterion. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is an assessment column. The column entries indicate the important steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

Support of tutor is the third criterion. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries explains the approach so that this kind of effectiveness can be brought to the criterion. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The fourth criterion is: Lack of communication. The second column entries related to this criterion indicate the outcome in which this criterion will finally result into. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Lack of communication .The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

Face to face discussion of student's performance is the fifth criterion. The second column entries related to this criterion indicate what this criterion may contribute as outcome. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Face to face discussion of student's performance. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The sixth criterion is: a well explained content. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: a well explained content of student's performance. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

Qualification and experience of Tutor is the seventh criterion. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Qualification and experience of Tutor. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The eighth criterion is: Problem based learning. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Problem based learning. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

Ease of use of LMS is the ninth criterion. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate the approach so that this kind of effectiveness can be brought to the criterion: Ease of use of LMS. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The tenth criterion is: Provision of synchronous and asynchronous facility. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate the approach so that this kind of effectiveness can be brought to the criterion: Provision of synchronous and asynchronous facility. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

Availability of communication services is the eleventh criterion. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate the approach so that this kind of effectiveness can be brought to the criterion: Availability of communication services. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The twelfth criterion is: Modernized technology enhanced infrastructure. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate the approach so that this kind of effectiveness can be brought to the criterion: Modernized technology enhanced infrastructure. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The clearly defined policies and procedures is the thirteenth criterion. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate the approach so that this kind of effectiveness can be brought to the criterion: Clearly defined policies and procedures. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The fourteenth criterion is: Resistance to embrace change by stakeholders. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Resistance to embrace change by stakeholders. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

Strong leadership is the fifteenth criterion. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Strong leadership. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The Sixteenth criterion is: Formal and informal kind of assessment. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Formal and informal kind of assessment. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The seventeenth criterion is: Well defined course structure. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Well defined course structure. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

A right blend of f2f and online activities is the eighteenth criterion. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: A right blend of f2f and online activities. The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

The nineteenth criterion is: Lack of sufficient funds and Resources. The second column entries related to this criterion indicate what this criterion contributes as results. The third column entries indicate about the approach so that this kind of effectiveness can be brought to the criterion: Lack of sufficient funds and Resources.The fourth column entries indicate the possible steps in the deployment process of the adopted approach. The fifth column is the assessment column. The column entries indicate the steps to assess this criterion so that one can expect to get the desired results. The last column entries indicate the suggestions to refine this criterion in future.

5.4.1 Validation by Expert's opinion

The expert opinion is taken on the RADAR method approach. His advice was to add one more entry in the fourth column of sixteenth criterion: Formal and informal kind of assessments. He recommended adding this entry: To design carefully the assessments in accordance to different levels of mastery of learners. So changes are made in the fourth column of deployment process of adopted approach. The new entry is marked as entry starting with the word underlined as **new** in Table 5.5.

5.4.2 Implication of RADAR Approach

The institutions can refer to this Table 5.5 and can implement the suggested method to assess and refine each criterion. They can also modify the given Table 5.5 as per their requirements and future expectations. The results (results of a relationship with people, customer, society, and key activities) give an overview of difference between the perception and actual performance indicators which help organizations to make a strategy to minimize this difference to please all concerned stakeholders. This assessment method can help bring excellence in the blended learning environment.

5.4.3 Benefits of Application of EFQM Model

The use of the EFQM in assessing the cause criteria can help institutions to do self-assessment and take necessary steps to overcome the shortcomings. The institution can do the self-assessment of their quality by following the weightings as being mentioned in the following Table 5.6 on the official site (www.efqm.org). These weights were revised in 2010. The self-evaluation helps an organization to identify its strengths and the areas for improvement.

The institutions can either refer the Table 5.5 for assessing the quality of BLE or the institutions can develop their own assessment method of all cause criteria in accordance to Table 5.6.

The Table 5.6 can be used by the institutions to do their self-assessment. The first column is about the main criterion of the EFQM model which covers the total nine entries. The second column indicates the sub criteria related to main criterion. The last column indicates the points value related to the sub criteria. Each enabler has got few sub criterion as being mentioned in Table 5.6.All sub criterion has got weights. For example, the leadership enabler has got five sub criteria. All five sub criteria have got equal weightage (20 points). Similarly, the strategy enabler has got four sub criteria with equal weightage (25 points).The People enabler has five sub criteria with equal weights of 20 points. The Partnership and resources enabler has total five sub criteria with equal weights of 20 points each. The five sub criteria in Processes enabler also has got equal weights of 20 points each. The Customer results has got two sub criteria with two different weights. The People results has also two sub criteria with two different weights. Similarly, the Society results also has got two sub criteria with total weight of 100.Lastly, the Key results has total two sub criteria with total weight of 100.

The institutions can follow Table 5.6 and assign the prescribed number of points in the presence of one particular sub criteria. The total number of maximum possible weights is1000 in number. After full inspection of the BLE, the institutions can add all those points which they deserve to get according to their performance, and hence, they can evaluate themselves at what level they are presently and how much more effort they need to put to reach to their expected level.

Table 5.6 Assigning weights

Criteria	Subcriteria	Weighting
(1) Leadership	(1a) Leaders develop the mission, vision, values and ethics and act as role models	20
	(1b) Leaders define, monitor, review and drive the improvement of the organization's management system and performance.	20
	(1c) Leaders engage with external stakeholders	20
	(1d) Leaders reinforce a culture of excellence with the organization's People	20
	(1e) Leaders ensure that the organization is flexible and manages change effectively	20
(2) Strategy	(2a) Strategy is based on understanding the needs and expectations of both stakeholders and the external environment	25
	(2b) Strategy is based on understanding internal performance and capabilities	25
	(2c) Strategy and supporting policies are developed, reviewed and updated to ensure economic, societal and ecological sustainability	25
	(2d) Strategy and supporting policies are communicated and deployed through plans, processes and objectives	25

Criteria	Subcriteria	Weighting
(3) People	(3a) People plans support the organization’s strategy	20
	(3b) People’s knowledge and capabilities are developed	20
	(3c) People are aligned, involved and empowered	20
	(3d) People communicate effectively throughout the organization	20
	(3e) People are rewarded, recognized and cared for	20
(4) Partnership and resources	(4a) Partners and suppliers are managed for sustainable benefit	20
	(4b) Finances are managed to secure sustained success	20
	(4c) Buildings, equipment, materials and natural resources are managed in a sustainable way	20
	(4d) Technology is managed to support the delivery of strategy	20
	(4e) Information and knowledge are managed to support effective decision making and to build the organizational capability	20
(5)Processes, products and services	(5a) Processes are designed and managed to optimize stakeholder value	20

Criteria	Subcriteria	Weighting
	(5b) Products and Services are developed to create optimum value for customers	20
	(5c) Products and services are effectively promoted and marketed	20
	(5d) Products and services are produced, delivered and managed	20
	(5e) Customer relationships are managed and enhanced	20
(6)Customer results	(6a) Perception	75
	(6b) Performance indicators	25
(7) People results	(7a) Perception	112.5
	(7b) Performance indicators	37.5
(8) Society results	(8a) Perceptions	50
	(8b) Performance indicators	50
(9) Key results	(9a) Key outcomes	75
	(9b) Key indicators	75

Furthermore, the institutions can use the EFQM method as a way to benchmark with other organizations and to compare and identify areas for improvement. In the next section summary is written.

5.5 Summary

In this chapter, the framework is developed by combining the results of learner's responses, faculty responses and lastly expert's responses. The framework is an attempt to optimize the quality of BLE in HES by involving all important stakeholders. The reason for integrating the opinions of these stakeholders is "to bring the perspectives of different stakeholders holistically". The subjective nature of quality is blended with the decision making techniques in order to bring more excellence and reliability.

Thus, a thorough review of literature on blended learning, TQM, and other related assessment models has revealed a set of 33 variables under six main factors. The DEMATEL technique is applied on faculty responses. This method divides the factors and criteria into the cause group (cause factors and cause criteria) and effect group (effect factors and effect criteria). The DEMATEL technique is also used to find out the most influenced, the most impacted, and the most related (factor and criterion) respectively. This division helps the decision makers to pay more attention to the factors and criteria which are under the cause group because the factors and criteria which are under the effect group are getting the effect from the cause group only. The MOORA technique has helped in ranking the levels of quality development implementation initiatives: at the individual level (Rank1), at the organizational level (Rank2) and, at the external stakeholder level (Rank3). Afterwards, the results of the DEMATEL and the MOORA method are combined by separating the cause criteria under three alternatives. In the end, the use of RADAR approach has being applied with the help of expert to give a view in order to bring more quality in BLE. In the next chapter, the conclusions and future areas of research are highlighted.

Chapter 6: Conclusions and Suggestions

6.1 Introduction

This thesis started with the aim to develop a TQM based assessment model for the BLE in the HES.

The main objectives of this research were:

1. To identify the relevant literature surrounding higher education sector, learning theories, learning styles, learning methods, blended learning, TQM, and use of TQM assessment tools in higher education sector.
2. To determine the important factors and criteria for the quality of BLE in learner's perspective and document them.
3. To determine the relationships among factors / criteria in the faculty's perspective and document them.
4. To assess the priority of quality development management strategies in the perspective of employer and quality experts.
5. To develop a TQM based framework by integrating all the above mentioned perspectives and by applying European Foundation for Quality Management (EFQM) model.
6. To refine and validate the framework.

Table 6.1 Meeting the objectives

Adopted technique	Meeting of above mentioned Objectives
Literature review, Pilot study (35 respondent and 4 Interviews)	Objective 1
Factor Analysis(SPSS) **(conducted on learners responses)(267/275 clean data)**	Objective 2
DEMATEL **(conducted on faculty responses)(2 experienced faculty members)**	Objective 3
MOORA method **(Conducted on employer and experts responses)(total 3 experts)**	Objective 4
Formation of Framework	Objective 5
Sensitivity Analysis, EFQM method	Objective 6

In Table 6.1, the first objective is satisfied after reviewing literature on importance of higher education sector, learning theories, learning styles, learning methods, blended learning, and TQM and its tools .The sub sections 2.3.2.1, 2.3.2.2 and 2.3.2.3 and section 2.2, 2.6 and 2.7 are related to that. The important factors for the BLE are represented in Table 2.1 in Chapter 2. Moreover, a pilot study in one of the premiere blended learning institutions in Dubai and interviews at different levels by taking different stakeholder opinions has helped in understanding the real life meaning of quality in the BLE.

The second objective is satisfied by applying Exploratory factor Analysis on the learners responses. The responses are collected through the refined questionnaire (after pilot study and interviews) which is redesigned by framing the questions in terms of pedagogical, technical, social, organizational and assessment and evaluation aspect to assess the quality of BLE from the learners. All the extracted factors and underlying criteria are documented.

The Third objective is met by applying the DEMATEL technique on faculty responses. The cause and effect relationship of factors/ criteria is established through this technique. The results are documented.

The fourth objective is fulfilled by applying the MOORA technique on external stakeholder's opinions. This technique helps in prioritization of QDI as management strategy.

The fifth objective of designing a framework is satisfied by combining the results of Factor analysis on learner responses, by applying the DEMATEL technique on faculty responses, by applying the MOORA method on external stakeholder response, and lastly, by applying the EFQM model. The adopted methodologies, complete analyses and formation of framework are presented in Chapters 3, 4 and 5.

The sixth objective of validation is satisfied through the Sensitivity analysis and expert advice for EFQM model.

6.2 Reflection

This research started with the intent to answer two research questions:

1. How is the quality of the BLE in HES important for its learners and its associated community?
2. How to develop a TQM based assessment framework in BLE which can help in the improvement of the quality of HES?

The first question is answered in Chapter 2 by explaining in detail the importance of superior quality of the BLE in the HES through different perspectives: learner, industry, and government. The HES has been revolutionized with the adoption of the quality BLE. This field is of significant importance because the high quality of learning environment in the higher education institutions can not only impact the development of skills and abilities of their learners, but it can also be a significant cause factor for the successful future development of any associated community, society, and more importantly for a nation. The quality learning experiences of learners can help them survive even in the harsh conditions of global market. The quality of the BLE involves learners, faculty members, middle management representatives, top management representatives, and external stakeholders so that the whole community gets its holistic benefits by the adoption of this model.

The second question is answered by the development of the TQM based assessment framework. The four main elements of quality assessment are controlled. Firstly, the Cost of Poor Quality (COPQ) element is controlled. The COPQ can be defined as the difference between the actual cost of production and service and the cost of production /service in ideal situation (which are defect free and meeting customer needs).The COPQ is tried to be controlled by making an attempt to involve all the important stakeholders: learners, faculty and quality experts. The framework is designed by taking all important stakeholders opinions. Thus, the first attempt to bring quality in the assessment framework is by adding the customer perspective and expectations.

Then another step is taken towards controlling the COPQ quality by applying the DEMATEL technique to find out the cause factor group, cause criteria group, effect factor group, and the effect criteria group through the faculty (internal stakeholder) perspective. The cause and effect groups can also help the organization make necessary and needful changes to improve the quality parameters of the BLE. In fact, the organizations can focus only on the cause group and its quality because the effect group parameters are only getting influence from the cause group parameters and hence will automatically improve without any extra effort. Thus a logical attempt of controlling the element of cost and its related COPQ.

Lastly, by applying the MOORA method, cost factor is controlled by ranking of alternatives. The ranking helps in the implementation of effective strategy (more accurate, because of the use of decision making technique) and for the quality development of BLE.

For the ranking of alternatives, the practitioners of quality from the industry and academia (external stakeholder) are consulted to incorporate the industry perspective. This helps in designing the suitable development strategy which itself helps in improving the COPQ parameter.

Secondly, quality culture is established by involving all stakeholders in quality development implementation initiatives by applying the MOORA method. The development of this assessment framework has pointed out the involvement of everyone to obtain the desired results of quality in the higher education sector. The three alternatives as QDI strategy highlights the importance of all important stakeholders. Employees in all organizations have their own different interests, beliefs, and practices concerning quality. All these together constitute the quality culture.

During the development of this framework, I have strongly adopted this element by taking three alternatives: quality development initiative at the individual level, quality development initiative at the organizational level, and quality development initiative by integration of all the external stakeholders. The ranking or prioritization of all these alternatives through the MOORA method is again an attempt to provide a logical approach to the organization to develop a continuous quality culture organically.

Thirdly, assessment of the market availability of different products and services in the BLE was in process while conducting interviews and evaluating answers of learners on question 38 of questionnaire. This element highlights the need to collaborate effectively with the other HEIs parts all over the world to adopt new innovative and challenging tasks to maintain high quality in the higher education sector.

It is important to understand the position of an institution in the market place. The market study should be taken by all departments of the institution to give an idea of: (1) What really be the relative importance of various quality products and services (in BLE) as seen by the user? (2) For each of the key qualities, how does the institution’s product/service comparable with the competitor’s product/service, as seen by the users? (3) How likely does the customer purchase our product and service from us again or recommend us to others? All the answers to these questions need to be based on the input data collected from the customers. Processes can be assessed in the market place through the process of benchmarking.

During the development of this framework, interviews were taken from the top management, middle management, and a faculty member. Moreover, learners have also given some suggestions by the last question in the questionnaire: "Please highlight one feature of blended learning which has benefitted you the most and one which you think needs to be introduced in future". The whole idea of asking this question is to get an understanding of what is available in the market and what are the future expectations of learners from the BLE. These learners represent different institutions, and hence, an appropriate attempt was made to get the right information from the market

Lastly, the EFQM model is applied in order to maintain and enhance the existing quality level of the BLE in the higher education sector. By adopting this model, the institution can achieve not only the expected level of quality for a cause variable, but also, it can help in identifying the opportunities for improvement. Conti (1997) stressed self-evaluation. The assessment can be taken by comparing the position of current quality activities with the help of an accepted system model European Foundation of Quality Management (EFQM) award.

In this research, the EFQM model to provide a reference so that the organizations can achieve the excellence in the quality related activities. The EFQM model is applied only on the cause group criteria. The results of the DEMATEL and MOORA method are combined by dividing the cause criteria under three quality development initiatives as shown in the following Table 5.7. The implication of this combined result is that the institutions can prioritize the cause criteria as per the QDI and take necessary steps to assess it. Each criterion is assessed by the RADAR approach. RADAR signifies acronym of Results, Approach, Deployment, Assessment and Review. These are explained in Table 5.9.

Moreover, the institutions in the HES can modify this model as per the needs and expectations to work together globally with other international institutions to improve quality in the higher education sector.

6.3 Conclusions

The conclusions that can be drawn from this research are:

1. There are six major factors that affect the quality of the blended learning environment in the higher education sector: Course structure competence, Assessment and evaluation competence, Technical and technological competence, Organizational competence, Effective communication competence and instructor's competence in that order of priority.

2. Within Course structure competence factor (F1) , the criteria in priority are: Problem based learning, Well-defined course structure, Right blend of face-to-face and online learning activities, Appropriate use of delivery methods, Support of tutor to achieve the learning , Prompt and continuous feedback, and Personalization of course content and course structure i.e. (C_{11}…C_{17})

3. Within Assessment and evaluation competence factor (F2), the criteria in priority are: Positive return on investments on mass adoption, Self-assessment, Strong leadership, Evaluation by international standards, Formal and informal kind of assessment, Face to face discussion of student's performance, Reusability of content brings sustainability, and Social and Networking feature in that order of priority i.e. (C_{21}…C_{28})

4. Within Technical and technological competence factor (F3), the criteria in priority are: Provision of adequate technical components (synchronous and asynchronous), Modernized technology equipped infrastructure, Availability of communication services (24/7), Ease of use of learning management system, and an adequate online support system in that order of priority i.e. (C_{31}…C_{35})

5. Within Organizational competence factor (F4), the criteria in priority are: Collaboration with international universities, Awarding an authoritative degree, Clearly defined policies and procedures, Reduction of carbon emission, and improvement of retention rate by providing more flexibility i.e.(C_{41}…C_{45})

6. Within Effective communication and interaction competence (F5), the criteria in priority are: Lack of communication, Feeling of isolation, and Effectiveness of interactions (student-student, student-teacher, and student-content) i.e. (C_{51}…C_{53})

7. Within Instructor's competence factor (F6), the criteria in priority are: Prior knowledge of computers, Lack of sufficient funds and resources, Resistance to embrace change by stakeholders, Qualification and experience of tutor, and A well explained content i.e. (C_{61}…C_{65})

8. The cause and effect relationship of the factors are established through the DEMATEL technique. The factors, Technical and technological competence and Effective communication competence, are identified as the part of the cause group. The factors identified as part of the effect group are: Course structure competence, Organizational competence, Assessment and evaluation competence, and Instructor's competence. (See figure 5.1)

9. The factor, Technical and technological competence, is the **master influencer**. This factor is influencing all other factors in a most intense way. Thus, the QDI and related assessment parameters need to be applied carefully with lot of thoughtfulness. The factor: Instructor's competence is the **master receiver** and getting the highest influence from all other factors. So, the QDI and related assessment parameters can be liberal for this factor. The factor, Organizational competence, is the **highly related factor**. Hence, the quality development initiatives and related assessment parameters need to be applied with care.

10. The criteria in cause group are written in the descending order of their prominence as Qualification and experience of tutor, A well explained content, Prior knowledge of computers, Lack of sufficient funds and resources, A well-defined course structure, Support of tutor, Problem based learning , Right blend of f2f and online learning activities, f2f discussion of student's performance, Ease of use of learning management system, Provision of adequate (synchronous and asynchronous) facility, Formal and informal kind of assessment, Modernized technology equipped infrastructure, Resistance to embrace

change by stakeholders, Personalization of course content and course structure, Availability of communication services (24/7), Lack of communication, and Clearly defined policies and procedures (See Table 5.1). The design of the implementation strategy for quality enhancement must embed all these features carefully.

11. The cause and effect relationship of criteria are established through the DEMATEL technique. The criterion, Qualification and experience of tutor, influences the other criteria in the most significant way and is the **master influencer (criterion)**. Thus, the QDI on related assessment parameters need to be applied with paramount importance. The criterion, Collaboration with the international universities, is the **master receiver (criterion)**. So, the QDI on related assessment parameters can be liberal for this criterion. The criterion: An appropriate use of delivery methods, is identified as the **most related (criterion)**. Hence, the QDI on related assessment parameters for this criterion need to be applied with caution. High quality of this criterion can lead to high quality of other criteria also.

12. The effect group criteria are listed as: An adequate online support system, Appropriate use of delivery methods, Feeling of isolation, Evaluation by international standards, Prompt and continuous feedback, Effectiveness of interactions, Self-assessment, Improvement of retention rate, Awarding an authoritative degree, Social and Networking feature, Return on investment, Reduction of carbon emission, Sustainability feature, Collaboration with international universities.(see Table 5.2)

13. In real a situation, organizations can opt to focus on only cause criteria because if institutions can optimize the quality dimension of all cause criteria, then effect criteria quality will be optimized automatically without any extra effort.

14. Four out of 6 components with the highest factor loadings are part of the cause group. The criteria, C_{11} (Problem based learning), C_{41} (Provision of adequate technical components synchronous and asynchronous), C_{51} (Lack of communication), and C_{61} (Prior knowledge of computers), are having **highest factor loadings**, and they are part of the cause group.

This result also implies that assessment of the cause group criteria has to be of the first priority under the constraints of limited time, funds, and resources.

15. The study of **impact relation under factor F1** has concluded that the criterion C_{12}: A well -defined course structure, holds the highest priority, and this criterion is the master influencer of factor F1. The criterion C_{16} (continuous and prompt feedback) is acting as the master receiver. The criterion C_{14} (appropriate use of delivery methods) is the most related criterion of this factor(see Figure 4.8)

16. The study of **impact relation under factor F2** has concluded that the criterion C_{23} (strong leadership) has dispatched the highest influence under this factor. The criterion C_{27} (sustainability feature) has received the highest influence from the other criteria of this factor. The criterion C_{27} is the master receiver of this factor. The criterion C_{24} (self-assessment) is the highly related criterion of this factor 2 (see Figure 4.9).

17. The study of **impact relation under factor F3** has concluded that the criterion C_{34} (Ease of use of LMS) has the highest influence under this factor. The criterion C_{35} (an adequate online support system) has received the highest influence from the other criteria of this factor. The criterion C_{35} is the master receiver of this factor. The criterion C_{31} (provision of adequate synchronous and asynchronous facility) is the highly related criterion of this factor (see Figure 4.10).

18. The study of **impact relation under factor F4** has concluded that the criterion C_{43} (clearly defined policies and procedures) has dispatched the highest influence under this factor. The criterion C_{41} (collaboration with international universities) has received the highest influence from the other criteria of this factor. The criterion C_{41} is the master receiver of this factor. The criterion C_{43} (clearly defined policies and procedures) is the highly related criterion of this factor (see Figure 4.11).

19. The study of **impact relation under factor F5** has concluded that the criterion C_{51} (lack of communication) has dispatched the highest influence under this factor. The criterion C_{53}

(effectiveness of interactions) has received the highest influence from the other criteria of this factor. The criterion C_{53} is the master receiver of this factor. The criterion C_{53} (effectiveness of interactions) is the highly related criterion of this factor (see Figure 4.12).

20. The study of **impact relation under factor F6** has concluded that the criterion C_{64} (qualification and experience of tutor) holds the highest priority. This criterion is the master influencer of factor F6. The criterion C_{63} (resistance to embrace change by stakeholders) is acting as the master receiver .This criterion is impacted by all other criteria critically under this factor. The criterion C_{64} (qualification and experience of tutor) is the most related criterion of this factor (see Figure 4.13).

21. The application of the MOORA method by taking external stakeholder's opinions has helped in ranking the three alternatives. This alternative, QDI at the individual level, is ranked as number one. The alternative, QDI at the organizational level, is ranked at number two. The last alternative, QDI at the external stakeholder's level, is ranked at number three. If the MOORA method is applied only on the cause group criteria, then also, there is no change in the ranking of alternatives.

22. The two methods, Entropy method and standard deviation method (for assigning the weights to criteria), are applied separately in the MOORA method and have resulted in the same ranking for alternatives. The same ranking from these two methods validates the authenticity of this ranking.

23. The ranking of these three levels through mathematical techniques can help the decision maker apply this result with full confidence and use the tangible resources like provision of facilities, equipment , personnel , money, and intangible resources like time in a more logical and structured way.

24. The use of sensitivity analysis validates the robustness of this framework. The analysis ends with the assurance that the present system of ranking of the alternatives: A1, A2 and A3 is quite robust.

25. The content analysis of question 38 in the questionnaire instrument highlighted a few features which have great benefit to the learners. These are the use of collaborative environment, recorded lectures, virtual labs, video conferencing, and ease of availability anywhere (on smart phones, tablets, laptops). The learners have also suggested a few features to be included in future design of the BLE. These are: careful planning of course content, availability of at least three video lectures on the same topic explained by three different faculty members, and strong organizational leadership. Also, a combination of these suggestions, maturity levels and competence stages, will be of great interest for future researchers.

26. All the cause group criteria are divided into five enablers of the EFQM: leadership, people, policy and strategy, partnership and resources, and processes (see Table 5.4)

27. The RADAR approach has been used in assessment of each cause group criterion which can be adopted as a self-assessment tool for assessing the quality of the BLE of institutions of the HES.

6.4 Results of This Research

Following are some of the contributions of this research.

- Documentation of success factors for assessing the quality of a BLE in the HES is provided. There are total 6 factors and 33 criteria which are identified from the review of literature. These factors and criteria are divided into cause group and effect group.
- This thesis develops a TQM based assessment framework for attaining the optimum quality in the BLE. The EFQM method is applied on the cause group criteria to assess their quality.
- This thesis provides a framework which has attempted to combine the responses of learner, faculty, and external stakeholders to develop an assessment framework. The study provides a self-assessment tool to help institutions improve their quality in BLE.
- This research also highlights the opportunities for further development of the assessment framework.

  In the next section, the limitations of this research are discussed.

6.5 Limitation

The limitations of this thesis are discussed in a following way:

- The use of decision making techniques like the DEMATEL and the MOORA are dependent upon the opinions and perceptions of decision makers, and hence, the chances of error involved cannot be over looked.
- The use of the RADAR approach on the cause criterion can vary from institution to institution, and hence, may require needful changes.

  The next section deals with the related future area of research.

6.6 Future Area of Research

This thesis presents the hybrid application of the concept of the DEMATEL and the MOORA (decision making techniques). The DEMATEL has primarily been used in the areas of: development strategies, management systems, e-learning evaluations, knowledge management, etc. The MOORA has primarily been applied in manufacturing. However, for this research, both the methods are combined and applied to the blended learning environment. In future research, the following directions are suggested:

- First, the objective weights of criteria are not considered in this developed assessment model. The subjective weights are undoubtedly highly dependent on the expert personal judgments, which may result in some errors because of lack of knowledge, experience, and data. Thus, it is necessary to develop a new approach for assessing the BLE which can take into account subjective and objective weights of criteria simultaneously.
- Second, the proposed assessment model is developed to deal with the vagueness and ambiguity in the decision making process. However, the initial linguistic information may be lost in processing since the computation results most of the time do not exactly match with the initial linguistic terms. Moreover, use of more than two decision maker's opinions of the MOORA and the DEMATEL technique should be investigated in the future.
- Additionally, a very few decision making techniques have been employed in the field of the blended learning environment in the higher education sector. Therefore, in future, other methods (e.g., TOPSIS, PROMETHEE, ELECTEREE and COPRAS, etc.) can also be applied.
- This research presented a model for the BLE for the higher education sector. Further research is needed to adapt this model for other sectors, like primary and secondary education, and for conducting training programs for the government and industry.
- For the purpose of this research Stracke's definition of quality development was used in the application of the MOORA method. However, there are other definitions as well. Future researchers can also look at modifying the model using other definitions of quality development.
- For the purpose of this research we have used the EFQM model only on the cause group criteria, but in future researchers can look at the possibility of extending this model to the effect group criteria also.
- Apart from the introduction of suggested framework, a variety of solutions from leading companies like IBM or SAAS can be used in the education sector to bring more

engagement, flexibility, participation, interaction, and innovation in the learning environment. These are: administrative solutions, asset management for education, campus solutions for covering cloud computing, virtualization, data analytics, networking solutions, and virtual lab facility.

- In the process of quality development, the following levels of maturity are defined as per Table 6.2. Higher education institutions can take this as a starting point and decide further improvements on the basis of what level they are with reference to Table 6.2. These maturity levels can further help the higher education institution in taking the appropriate improvement initiatives in enhancing the quality in the BLE.

Table 6.2 Indicators of Maturity level

DIMENSION	DESCRIPTION
Planning (Level 1)	The institution plans and guides the quality development strategy of BLE.
Providing (Level 2)	The institution provides the quality development strategy of BLE.
Monitoring (Level 3)	The institution monitors regularly the quality development strategy of BLE.
Optimizing (level 4)	The institution improves continuously the quality development strategy of BLE.

For the sustainable quality development of the BLE, HEIs must try to connect with the industry and society actively and efficiently. The self-reliance of universities can ease the pressure of shrinking funds and resources .The learners will not hesitate in taking risks. The number of entrepreneurs will increase. Indeed, this will be the real achievement.

- The higher education institution can decide the competence level of all deduced criteria of the BLE in accordance to their needs, availability of resources, and power to spend on the improvement initiatives. For example, the competence level of criterion C_{17} (Personalization of course content and structure) is explained and its five stages (0, 1, 2, 3, 4) of competence are defined in Table 6.3.

Table 6.3 Competence Context: Stage 0

Name of the Competence	**(Criterion)Personalization of Course content and structure under TQM perspective.**
Knowledge required for this competence	Minimal knowledge of TQM techniques and tools, knowledge of different learning styles.
Skills required for this competence	Development of right course content with apt combination of technological tools and with right integration of synchronous and asynchronous techniques.
Activities required for this competence	As per the learner's needs and learning styles.
People required for this competence	Subject experts, e learning experts, content writers, technological experts, support staff, peer group, industry representative for the relevant activities.
What needs to be done to delight the learner and improve the learning process	Continuous improvements in all the concerned activities in a regular and consistent manner.

Competence Description: Stage 1:

1. Personalization for all learner styles in mind.
2. Ease of use for learners to extend learning opportunities.
3. Design requires minimum level of understanding as per the European quality framework.
4. A seamless and continuous gain of knowledge at each stage.

Competence Building: Stage 2:

1. Train the people on total quality management tools and techniques.
2. Involvement of groups of people like course designers, subject expert, and subject related industry experts.

3. Involvement of groups of students and most importantly the peer group.
4. Introduction of multimedia components.
5. Introduction of synchronous and asynchronous kinds of communication activities.
6. Sponsor training and workshops on related subject areas.

Competence Measurement: Stage 3:

1. To do continuous and regular inspection of present level of activities and update new activities.
2. To call peer groups to evaluate the present level of competence and give feedback.
3. To bring innovation and change by technology savvy activities on a regular basis.
4. To take the feedback of learners on a regular basis.
5. To take the feedback of instructors on a regular basis.

Competence Evaluation by the Kirkpatrick model and the EFQM: Stage 4:

1. Assessing the results of learners and their reaction.
2. Assessing the level of mastery attained by learners.
3. Assessing the satisfaction level of learners and evaluators.
4. Assessing the means of communication used and their future update.

I suggest the same kind of competence stages for all of the criteria in future research.

Finally, with the end of this section, the description of whole research ends.

References

Aldridge, J. M., Fraser, B. J., & Sebela, M. P. (2004). Using teacher action research to promote constructivist learning environments in South Africa. *South African Journal of Education*, *24*(4), 245-253.

Al-Hunaiyyan, Al-Doub, E., Goodwin, R (2008). Student's attitudes toward e-learning in Kuwait's higher education institutions. Retrieved October, 15, 2010.A. (2008).

Allen, I. E. and Seaman, J. (2005).Growing by Degrees: Online Education in the United States, 2005. Needham, MA: Sloan Consortium.

Allen, I. E., & Seaman, J. (2008). Staying the course: Online education in the United States, 2008.Needham, MA: The Sloan-C Consortium.

Allen, I. E., Seaman, J., & Garrett, R. (2007). Blending in. The Extent and Promise of Blending Learning in the United States. Proceedings of the Sloan Consortium.

Amaratunga, D., Baldry, D., & Sarshar, M. (2000). Assessment of facilities management performance–what next?. Facilities, 18(1/2), 66-75.

Anderson, J.C., Rungtusanatham, M., & Schroeder, R.G. (1994). A theory of quality management underlying the Deming Management Method. Academy of Management Review, 19(3), 472–509.

Andy Fields (2005) Discovering Statistics Using SPSS, Second Edition. Sage Publications.

Arbaugh, J. B. Godfrey, M. R. Johnson, M. Pollack, B. L. Niendorf, B. & Wresch, W. (2009). Research in online and blended learning in the business disciplines: Key findings and possible future directions. The Internet and Higher Education, 12(2), 71-87.

Arbaugh, J. B., & Duray, R. (2002). Technological and structural characteristics, student learning and satisfaction with web-based courses an exploratory study of two on-line MBA programs. *Management Learning*, *33*(3), 331-347.

Arbaugh, J. B., Desai, A., Rau, B., & Sridhar, B. S. (2010). A review of research on online and blended learning in the management disciplines: 1994–2009. Organization Management Journal, 7(1), 39-55.ARTICLE IN PRESS

Attwell, G. (2006). Evaluating E-learning: A Guide to the Evaluation of E-learning. *Evaluate Europe Handbook Series*, *2*, 1610-0875.

Aycock, A., Garnham, C., & Kaleta, R. (2002). Lessons learned from the hybrid course project. Teaching with Technology Today, 8(6). Retrieved from http://www.uwsa.edu/ttt/articles/garnham2.htm

Badrul H. Khan, Ph.D Laura A. Granato,Ph.D.(2006)" Program Evaluation in Learning",[http://www.badrulkhan.com/](Accessed 2007, June 3)

Badrul H. Khan (2007), "Flexible learning in an information society"available on: http://asianvu.com/bk/resume.pdf

Barnett, R. (2003). Engaging students. In S. Bjarnason & P. Coldstream (Eds), *The idea of engagement: Universities in society*. London: Association of Commonwealth Universities.

Barrie, S. C., & Ginns, P. (2007). The linking of institutional performance indicators to improvements in teaching in classrooms. Quality in Higher Education, 13, 275–286.

Bell, F., & Heinze, A. (2004). With regard to respect: a framework for governance of educational virtual communities. *International Journal of Web Based Communities*, *1*(1), 19-34.

Biggs, J., & Tang, C. (2011). Teaching for quality learning at university. McGraw-Hill International.
Birenbaum, M. (2007). Assessment and instruction preferences and their relationship with test anxiety and learning strategies. *Higher Education*, *53*(6), 749-768.
Bliuc, A. M., Goodyear, P., & Ellis, R. A. (2007). Research focus and methodological choices in studies into students' experiences of blended learning in higher education. The Internet and Higher Education, 10(4), 231-244.
Bloom, B. S. (1956). Taxonomy of educational objectives: the classification of educational goals. Handbook
Bonk, C. J., & Graham, C. R. (2006). The handbook of blended learning. *Global perspectives*, local designs, 1, 83.
Bonk, C. J., & Graham, C. R. (Eds.). (2005). Handbook of blended learning: Global perspectives, local designs. San Francisco, CA: Pfeiffer Publishing.
Bonk, C. J., Kim, K. J., & Zeng, T. (2006). Future directions of blended learning in higher education and workplace learning settings. In C. J. Bonk & C. R. Graham (Eds.), Handbook of blended learning: Global perspectives, local designs (pp. 550-567). San Francisco: Pfeiffer Publishing.
Bonk, C., Kim, K. J., & Zeng, T. (2005, June). Future directions of blended learning in higher education and workplace learning settings. In World Conference on Educational Multimedia, Hypermedia and Telecommunications (Vol. 2005, No. 1, pp. 3644-3649).

Bose, K. (2003). An e-learning experience—a written analysis based on my experience in an e-learning pilot project. Campus-Wide Information Systems,20(5), 193–199.
Boud, D., Cressey, P., & Docherty, P. (Eds.). (2006). Productive reflection at work: Learning for changing organizations. Routledge.
Boyle, T. (2005). A dynamic, systematic method for developing blended learning. Education, Communication & Information, 5(3), 221-232.
Boyle, T., Bradley, C., Chalk, P., Jones, R., & Pickard, P. (2003). Using blended learning to improve student success rates in learning to program.*Journal of educational Media*, *28*(2-3), 165-178.
Brah, S. A., Tee, S. S., & Rao, B. M. (2002). Relationship between TQM and performance of Singapore companies. *International Journal of Quality & Reliability Management*, *19*(4), 356-379.
Brauers, W. K. 2004. Optimization methods for a stakeholder society. Boston: Kluwer Academic Publishers.

Brauers, W. K. M., and Zavadskas, E. K., (2006). The MOORA method and its application to privatization in a transition economy, Control and Cybernetics, Systems Research Institute of the Polish Academy of Sciences, 35(2), pp 445–469.
Bricheno, P., Higginson, C. & Weedon, E. (2004), `The Impact of Networked Learning on Education Institutions´. The JISC INLEI Project. http://www.sfeuprojects.org.uk/inlei/. Accessed

25 August 2007.
Brookes, M., & Becket, N. (2007). Quality management in higher education: a review of international issues and practice. *International Journal of Quality Standards*, *1*(1), 85-121.
Brown, G., & Bull, J. M. Pendlebury (1997) Assessing student learning in higher education.

Brown, J. D. (2001). Using surveys in language programs. Cambridge University Press.
Browne, T., & Jenkins, M. (2003). VLE Surveys: A longitudinal perspective between March 2001 and March 2003 for Higher Education in the United Kingdom. *UCISA Report. Retrieved September*, *1*, 2004.

Castle, S. R., & McGuire, C. (2010). An analysis of student self-assessment of online, blended, and face-to-face learning environments: Implications for sustainable education delivery. *International Education Studies*, *3*(3), P36.

Cattell, R. B. (1966). The scree test for the number of factors. Multivariate behavioral research, 1(2), 245-276.
Chamberlain, M., Davis, L., & Kumar, M. (2005). The University of Houston embraces hybrid instruction. Texas Journal of Distance Learning, 2(1), 17-23.
Chang, C. W., Lee, J. H., Wang, C. Y., & Chen, G. D. (2010). Improving the authentic learning experience by integrating robots into the mixed-reality environment. Computers & Education, 55(4), 1572-1578.
Cheetham, G., & Chivers, G. (2001). How professionals learn in practice: an investigation of informal learning amongst people working in professions. *Journal of European Industrial Training*, 25(5), 247-292.
Chen, N. S., Ko, H. C., Kinshuk*, & Lin, T. (2005). A model for synchronous learning using the Internet. Innovations in Education and Teaching International, 42(2), 181-194.
Cheng, Y. M. (2011). Antecedents and consequences of e-learning acceptance.Information Systems Journal, 21(3), 269-299.
Chin, C. and Brown, D.E. (2000) Learning in science: a comparison of deep and surface

Chin, C., & Brown, D. E. (2002). Student-generated questions: A meaningful aspect of learning in science. *International Journal of Science Education*, *24*(5), 521-549.

Commission of the European Communities (2000). Report from the commission to the council and the European Parliament: Designing tomorrow's education promoting innovation with new technologies. Brussels,Belgium. Retrieved March 28, 2007, from ec.europa.eu/education/programmes/elearning/rapen.pdf

Commission of the European Communities (2008) Preparing Europe's digital future:communication technologies? ALT-J, Research in Learning Technology, 12(2), 113-Computers&Education, 38,267–285.

Creswell, J. W. (2009). Research design: Qualitative, quantitative, & mixed method approaches. Thousand Oaks, CA: Sage Publications.
D. R. Garrison and N. D. Vaughan, "Blended Learning in Higher Education: Framework, Principles, and Guidelines", Jossey-Bass an Inprint of Wiley, 200S.
Dale, E. (1969). The Cone of Experience. Chapter 4 in Audiovisual Methods in Teaching, 3rd ed., 107-135.
Damoense, M. Y. (2003). Online learning: Implications for effective learning for higher education in South Africa. Australian Journal of Educational Technology, 19(1), 25-45.
Davis, R., &Wong, D. (2007). Conceptualizing and measuring the optimal experience of the e-learning environment. Decision Sciences Journal of Innovative Education, 5(1), 97–126.
DeLone, W.H. and McLean, E.R. (2003), "The Delone and Mclean model of information systems success: a ten-year update", Journal of Management Information System, Vol. 19 No. 4, pp. 9-30.
Demirbag, M., Tatoglu, E., Tekinkus, M., & Zaim, S. (2006). An analysis of the relationship between TQM implementation and organizational performance: Evidence from Turkish SMEs. *Journal of manufacturing technology management*, *17*(6), 829-847.
Demirer, V. & Sahin, I. (2012). Development, implementation and evaluation of an online multimedia learning environment for blended learning. AWERProcedia Information Technology and Computer Science, 1.
Demirer, V., & Sahin, I. (2012). Development, implementation and evaluation of an online multimedia learning environment for blended learning. *Global Journal on Technology*, *1*.
Demirer, V., & Sahin, I. (2013). Effect of blended learning environment on transfer of learning: an experimental study. *Journal of Computer Assisted Learning*, *29*(6), 518-529.
Department for Education and Skills (DfES) (2003).Towards a unified e-learning strategy: consultation document (London, DfES).
Desire2Learn, "Blackboard Digital Content," http://www.desire2learn.com/, Online; accessed 22-Aug-2012.development in higher education. Open Learning, 20(1), 51-64. Development and Evaluation", Journal of Development, Vol. 27 No. 4, pp. 415-25
Dick, W., Carey, L., & Carey, J. (2001).The systematic design of instruction (5th ed.). New York: Addison-Wesley Educational Publishers, Inc.distance education. British Educational Research Journal, 31(1), 1-21.
Driscoll, M. (2002). Blended learning: Let's get beyond the hype, Learning and Training Innovations Newsline, Retrieved October 10, 2009
Duart, J. M., Gil, M., Pujol, M. & Castaño, J. (2008). La universidad en la sociedad red (1st ed.). Barcelona, Spain: UOC-Ariel.
Dunn, B. and Mathews, S. (2001), "The pursuit of excellence is not optional in the voluntary sector, it is essential", International Journal of Health Care Quality Assurance, Vol. 14 No. 3, pp. 121-5.

Dziuban, C., Hartman, J., & Moskal, P. (2004). Blended learning. ECAR Research Bulletin.Retrieved from http://www.educause.edu/ir/library/pdf/ERB0407.pdf

Easterby-Smith, M., Thorpe, R., & Jackson, P. (2008). Management research. Sage.
EFQM (2002), EFQM Homepage, available at: www.efqm.org/ new_website/training/self-assessment/self-assessment. htm (accessed 20 April).

El-Santawy, M. F., & Ahmed, A. N. (2012). A SDV-MOORA technique for solving multi-criteria decision making problems with no preference. LIFE SCIENCE JOURNAL-ACTA ZHENGZHOU UNIVERSITY OVERSEAS EDITION, 9(4), 5881-5883.
El-Santawy, Mohamed F., and Ramadan A. Zean El-Dean (2012). A SDV-MOORA Approach for Ranking Facility Locations. Life Science Journal, 9(2)
Entwistle N. J. (2000). Approaches to studying and levels of understanding: the influences of teaching and assessment. In J. C. Smart (Ed.), Higher Education: Handbook of Theory and Research (Vol. XV) (pp. 156-218). New York: Agathon Press.
Farley, A., Jain, A., & Thomson, D. (2011). Blended Learning in Finance: Comparing Student Perceptions of Lectures, Tutorials and Online Learning Environments Across Different Year Levels*. *Economic Papers: A journal of applied economics and policy*, *30*(1), 99-108.
Galusha, J.M. (1997, December). Barriers to learning in distance education. Interpersonal Computing and Technology: An Electronic Journal for the 21st Century, 5(3-4), 6-14. Retrieved March 13, 2007, from http://www.emoderators.com/ipct-j/1997/n4/galusha.html
Garnham, C., &Kaleta, R. (2002).Introduction to hybrid courses. Teaching with Technology Today, 8 (6). Retrieved 03.05.2009 from http://www.uwsa.edu/ttt/articles/garnham.htm
Garrison, D. R. (2011). E-learning in the 21st century: A framework for research and practice. Taylor & Francis
Garrison, D. R., & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. The Internet and Higher Education, 10(3), 157-172.
Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. The Internet and Higher Education, 7(2), 95−105.
Garrison, D. R., & Vaughan, N.D. (2008). Blended learning in higher education (1th ed.). San Francisco: John Wiley & Sons.
Gedik, N., Kiraz, E., & Ozden, M. Y. (2013). Design of a blended learning environment: Considerations and implementation issues. *Australasian Journal of Educational Technology*, *29*(1).
George-Walker, L. D., & Keeffe, M. (2010). Self-determined blended learning: a case study of blended learning design. *Higher Education Research & Development*, *29*(1), 1-13.
Giertz, B. (2000), “The quality concept in higher education”, paper presented to TQM for Higher Education Institutions II, Verona, Italy, 30-31 August 1999.
Gillham, B. (2008). Developing a questionnaire. Bloomsbury Publishing.

Ginns, P., & Ellis, R. (2007). Quality in blended learning: Exploring the relationships between on-line and face-to-face teaching and learning. The Internet and Higher Education, 10(1), 53-64.

Ginsberg, M.B. (1991) Understanding Educational Reforms in Global Context: Economy, Ideology and the State. Garland, New York, NY.

Graham Attwell, G (2006).Evaluating E-learning: A guide to the evaluation of E-learning. Evaluate Europe Handbook Series, 2 1610-0875.

Graham, C. R. (2006). Blended learning systems: definition, current trends, and future directions. In Handbook of Blended Learning: Global Perspectives , Local Designs , edited by C. J. Bonk and C. R. Graham, pp. 3–21. San Francisco, CA: Pfeiffer Publishing.*

Graham, C. R., & Dziuban, C. (2007). Blended learning environments. Handbook of Research on Educational Communications and Technology: A Project of the Association for Educational Communications and Technology, 2, 269.

Graham, C. R., Allen, S., & Ure, D. (2003). Blended learning environments: A review of the research literature. *Unpublished manuscript, Provo, UT*.

H.Wiklund, B.Klefsjo, P.Sandvik Wiklund and B.Edvardsson, "Innovation and TQM in Swedish higher education institutions – possibilities and pitfalls", The TQ M Magazine, Vol.15, No.2, 2003, pp. 99-107.

Harriman, G. (2004). What is blended learning?,E-Learning Resources, Retrieved October 13, 2009, from http://www.grayharriman.com/blended_learning.htm.

Harvey, L., & Knight, P. T. (1996). *Transforming Higher Education*. Open University Press, Taylor & Francis, 1900 Frost Road, Suite 101, Bristol, PA 19007-1598.

Selim M. H.(2007). Critical success factors for Elearning acceptance ConWrmatory factor models. Computers & Education 49 396–413, available online at:www.sciencedirect.com

Heinze, A. (2008). Blended learning: an interpretive action research study (Doctoral dissertation, University of Salford).

Heinze, A., & Procter, C. T. (2004). Reflections on the use of blended learning.

Herrington, J. (2006). Authentic e-learning in higher education: Design principles for authentic learning environments and tasks. In T. Reeves & S. Yamashita (Eds.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2006* (pp. 3164-3173). Chesapeake, VA: AACE.

Herrington, J., Reeves, T. C., & Oliver, R. (2006). Authentic tasks online: A synergy among learner, task, and technology. Distance Education, 27(2), 233-247.

Herrington, J., Reeves, T. C., & Oliver, R. (2007). Immersive learning technologies: Realism and online authentic learning. *Journal of Computing in Higher Education*, 19(1), 80-99.http://dx.doi.org/10.1007/BF03033421

Herrington, J., Reeves, T. C., & Oliver, R. (2010). *A guide to authentic e-learning.* New York: Routledge.

Heterick, B., & Twigg, C. (2003). The learning marketspace. Retrieved from

http://www.thencat.org/Newsletters/Feb03.html
Hicks, M., Reid, I., & George, R. (2001). Enhancing on-line teaching: Designing responsive learning environments. The Hinsdale, IL: The Dryden Press.
Ho, S. K., & Wearn, K. (1995). A TQM model for higher education and training.*Training for quality*, *3*(2), 25-33.
Holsapple, C.W. and Lee-Post, A. (2006), "Defining, assessing, and promoting e-learning success:an information systems perspective", Decision Sciences Journal of Innovative Education,Vol. 4 No. 1, pp. 67-85.
Hori, S., & Shimizu, Y. (1999). Designing methods of human interface for supervisory control systems. Control Engineering Practice, 7(11), 1413–1419.
Hsu, P. F.; Hsu, M. G. 2008. Optimizing the information outsourcing practices of primary care medical organizations using entropy and TOPSIS, Quality and Quantity 42(2): 181–201.
Hu, Z., & Zhang, S. (2010, June). Blended/hybrid course design in active learning cloud at South Dakota state university. In Education Technology and Computer (ICETC), 2010 2nd International Conference on (Vol. 1, pp. V1-63). IEEE.
Huang, C. Y., Shyu, J. Z., & Tzeng, G. H. (2007). Reconfiguring the innovation policy portfolios for Taiwan's SIP Mall industry. Technovation, 27(12), 744–765.
Huang, T. (2001). The relation of training practices and organizational performance in small and medium size enterprises. *Education & Training,* 43(8/9), 437-444.
Jolliffe, I. T. (2002).Discarding Variables in a Principal Component Analysis I: Artificial Data. Applied Statistics, 21(1972), 160-173.IEEE (2002). *1484.12.1 IEEE Standard for Learning Object Metadata.* Retrieved 25 February, 2009, from: http://ltsc.ieee.org/wg12/index.html

IEEE.International Conference, Manchester University, UK.,International Blackboard Inc, "Blackboard Digital Content, http://www.blackboard.com/Platforms/Learn/Products/Blackboard-Digital-Content.aspx, Online;International Journal for Academic Development, 6(2), 143–151.

Jackson, S. (1999).Exploring the possible reasons why the UK government commended the EFQM excellence model as the framework for delivering governance in the new NHS.International Journal of Health Care Quality Assurance, Vol. 12 No. 6, pp. 244-53.
Jamieson, P., Fisher, K., Gilding, T., Taylor, P. G., & Trevitt, A. C. F. (2000). Place and space in the design of new learning environments. Higher Education Research and Development, 19(2), 221-236.
JISC (2005). *Innovative Practice with e-Learning.* Bristol, UK: Joint Information Services Committee
Johnson, R.D., Hornik, S. and Salas, E. (2008), "An empirical examination of factors contributing to the creation of successful e-learning environments", International Journal of Human-Computer Studies, Vol. 66 No. 5, pp. 356-69.

Joiner, T. A. (2007). Total quality management and performance: The role of organization support and co-worker support. *International Journal of Quality & Reliability Management*, *24*(6), 617-627.

Jonassen, D. H. (1999). Designing constructivist learning environments.*Instructional design theories and models: A new paradigm of instructional theory*, *2*, 215-239.
Jones, N. (2006). e- College Wales, a case study of blended learning. In Handbook of Blended Learning: Global Perspectives,Local Designs, edited by C. J. Bonk and C. R.Graham, pp. 182–194. San Francisco, CA: Pfeiffer Publishing.
Jones, S. (2003). Measuring the quality of higher education: Linking teaching quality measures at the delivery level to administrative measures at the university level. Quality in Higher Education, 9(3), 223-229.
Kaiser, H. F. (1960). The application of electronic computers to factor analysis. Educational and psychological measurement.
Kaklauskas A, Zavadskas E, Trinkunas V. (2007).A multiple criteria decision support on-line system for construction. Eng Appl Artif Intell, 20,163–75.
Kanji, G.K., & Malek, A. (1999). Total quality management in UK higher education institutions. Total Quality Management, 10(1), 129–153.
Karadeniz, Ş. (2009). Flexible design for the future of distance learning. Procedia-Social and Behavioral Sciences, 1(1), 358-363.
Karapetrovic, S., Rajamani, D., & Willborn, W. (1998). ISO 9001 quality system: an interpretation for the university. *International Journal of Engineering Education*, *14*(2), 105-118.
Karsak, E. E., Sozer, S., & Alptekin, S. E. (2002). Product planning in quality function deployment using a combined analytic network process and goal programming approach. Computers & industrial engineering, 44(1), 171-190.
Katz, Y. J. (2002). Attitudes affecting college students' preferences for distance learning. Journal of Computer Assisted Learning, 18, 2–9
Keefe, J. W. (1987). Learning style theory and practice. VA: Reston.
Kerres, M., & Witt, C. D. (2003). A didactical framework for the design of blended learning arrangements. Journal of Educational Media, 28(2-3), 101-113.
Khan, B. H. (Ed.). (2005). Managing e-learning: Design, delivery, implementation, and evaluation. IGI Global.
Kim, K., Bonk, C., &Teng, Y. (2009). The present state and future trends of blended learning in workplace learning settings across five countries.Asia Pacific Education Review, 10(3), 299-308.
Kim, S. H., Mims, C., & Holmes, K. P. (2006). An introduction to current trends and benefits of mobile wireless technology use in higher education. AACE Journal, 14(1), 77-100.
Kirkley, J. R. and Kirkley, S. E. (2006). Expanding the boundaries of blended learning: transforming learning with mixed and virtual reality technologies. In Handbook of Blended Learning: Global Perspectives,Local Designs , edited by C.
Klein, H. J., Noe, R. A., & Wang, C. (2006). Motivation to learn and course outcomes: The impact of delivery mode, learning goal orientation, and perceived barriers and enablers. *Personnel Psychology, 59*(3), 665-702.

Klein, H. J., Noe, R. A., & Wang, C. (2006). Motivation to learn and course outcomes: The impact of delivery mode, learning goal orientation, and perceived barriers and enablers.

Personnel Psychology, 59(3), 665-702.
Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development* (Vol. 1). Englewood Cliffs, NJ: Prentice-Hall.
Kolb, D. A. (2005). The Kolb learning style inventory, Version 3.1. Boston, MA & London: Hay
Laurillard, D. (2002). Rethinking university teaching: A conversational framework for the effective use of learning technologies (2nd ed.). London: RoutledgeFalmer.
Lee, J. W., & Kim, S. H. (2000). Using analytic network process and goal programming for interdependent information system project selection. Computers & Operations Research, 27(4), 367-382.
Leone, S., Leo, T., & Chen, N. S. (2010, July). An Integrated Model of Synchronous Cyber Assessment and Blended Learning Environment for Foreign Language Learners. In *ICALT* (pp. 110-112).
Liaw, S.-S., Huang, H.-M. , Chen, G.-D. (2007), "Surveying instructor and learner attitudes toward e-learning", Computers & Education, Vol. 49 No. 4, pp. 1066-80.
Lim, D. H., & Johnson, S. D. (2002). Trainee perceptions of factors that influence learning transfer. *International journal of training and development*, *6*(1), 36-48.
Lim, D. H., & Kim, H. (2003). Motivation and learner characteristics affecting online learning and learning application. *Journal of Educational Technology Systems*, *31*(4), 423-439.
Lim, D. H., & Morris, M. L. (2009). Learner and Instructional Factors Influencing Learning Outcomes within a Blended Learning Environment. Educational Technology & Society, 12 (4), 282–293.
Lim, T., Fadzil, M., & Mansor, N. (2011). Mobile learning via SMS at Open University Malaysia: Equitable, effective, and sustainable.
Lin, C. L., & Tzeng, G. H. (2009). A value-created system of science (technology) park by using DEMATEL. *Expert Systems with Applications*, *36*(6), 9683-9697.
Lin, C. T., Chen, C. B., & Ting, Y. C. (2011). An ERP model for supplier selection in electronics industry.Expert Systems with Applications, 38(3), 1760–1765.
Lin, H. (2008). Blending online components into traditional instruction in pre-service teacher education: The good, the bad, and the ugly.International Journal for the Scholarship of Teaching and Learning, 2(1), 1-14.
Liou, J. J. H., Yen, L., & Tzeng, G. H. (2008). Building an effective safety management system for airlines. Journal of Air Transport Management, 14(1), 20–26.
Littlejohn, A., & Pegler, C. (2007). Preparing for Blended e-Learning. London: Routledge
Liu, L., Zhou, J., An, X., Zhang, Y., & Yang, L. (2010). Using fuzzy theory and information entropy for water quality assessment in Three Gorges region, China. *Expert Systems with Applications*, *37*(3), 2517-2521.
Liu, S. H., Liao, H. L., & Pratt, J. A. (2009). Impact of media richness and flow on e-learning technology acceptance. Computers & Education, 52(3), 599-607Locations. Life Sci J 2012;9(2s):120-122]. (ISSN: 1097-8135). http://www.lifesciencesite.com. 22

Lombardi, M. M. (2007). *Authentic learning for the 21st Century: An overview*. ELI White Papers, EDUCAUSE Learning Initiative.

MacDonald, C. J., & Thompson, T. L. (2005). Structure, content, delivery, service, and outcomes: Quality e-learning in higher education. *The International Review of Research in Open and Distributed Learning*, *6*(2).

Macias, I. & Dolan, M., 2009, 'Motivating international students: a practical guide to aspects of learning and teaching', in Davies, P. (Ed.), The Handbook for Economics Lecturers (Bristol, Higher Education Academy Economics Network).

Mackay, S. T., & Stockport, G. J. (2006). Blended learning: Classroom and e-learning. Business

Mackay, Stephen, & Stockport, Gary J. (2006). Blended learning, classroom and e-learning. The Business Review, 5(1), 82–88.

Malhotra, N. K., Agarwal, J., & Peterson, M. (1996). Methodological issues in cross-cultural marketing research: a state-of-the-art review. International Marketing Review, 13(5), 7-43.

Malhotra,,N.K and Birks, D.F (2007) Marketing Research: an applied Approach. 3rd European Edition. England: Prentice Hall

Mann, R., & Kehoe, D. (1994). An evaluation of the effects of quality improvement activities on business performance. *International Journal of Quality & Reliability Management*, *11*(4), 29-44.March 2001 and March 2003 for HE in the UK [online]. UCISA.

Martyn, M. (2003). The hybrid online model: Good practice.Educause Quarterly, 1, 18–23.

Masie, E. (2006). The blended learning imperative. In Handbookof Blended Learning: Global Perspectives LocalDesigns , edited by C. J. Bonk and C. R. Graham, pp. 22–26.San Francisco, CA: Pfeiffer Publishing.*

Mason, R. & Rennie, F. (2006). Elearning: The key concepts. London: Routledge

Mateo, J., & Sangrà, A. (2007). Designing online learning assessment through alternative approaches: facing the concerns. *European Journal of Open, Distance and e-Learning*.

Mayer, R. E. (2001). Multi-media learning (1th ed.). Cambridge University Press.

McLaren, C. H. (2004). A comparison of student persistence and performance in online and classroom business statistics experiences. Decision Sciences Journal of Innovative Education, 2(1), 1–10.

McNaught, C., & Lam, P. (2005). Building an evaluation culture and evidence base for e-learning in three Hong Kong universities. *British Journal of Educational Technology*, *36*(4), 599-614.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. Washington, DC: United States of America Department of Education.

Micu, D., Orza, B., PORUMB, S., & Porumb, C. (2012). Cloud computing and its application to blended learning in engineering. In *Conference proceedings of" eLearning and Software for Education"(eLSE)* (No. 02, pp. 253-258).

Micu, D., Orza, B., Porumb, S., & Porumb, C. (2012). Cloud computing and its application to blended learning in engineering. In *Conference proceedings of" eLearning and Software for Education"(eLSE)* (No. 02, pp. 253-258).
Mohamed F. El-Santawy and A. N. Ahmed. A SDV-MOORA Technique for Solving Multi-Criteria Decision
Mohamed, F., & Ahmed, A. N. (2013). An Information Entropy Weighting Method Combined to
Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e- Learning, online learning, and distance learning environments: Are they the same?. The Internet and Higher Education, 14(2), 129-135.
Mortera-Gutierrez, F. J. 2005. "Faculty best practices using blended learning in e-learning and face-face instruction". http://www.uwex.edu/disted/conference accessed 2 March, 2007.
Motteram, G. (2006). 'Blended' education and the transformation of teachers: A long-term case study in postgraduate UK higher education. British Journal of Educational Technology, 37(1), 17-30.
Murphy, E. (2004). Recognising and promoting collaboration in an online asynchronous discussion. British Journal of Educational Technology, 35(4), 421-431.
Nemanich, L., Banks, M., & Vera, D. (2009). Enhancing knowledge transfer in classroom versus online settings: The interplay among instructor, student, content, and context. Decision Sciences Journal of Innovative Education7 (1), 123–148.
Neumeier, P. (2005). A closer look at blended learning—parameters for designing a blended learning environment for language teaching and learning. ReCALL, 17(02), 163-178.
Newton, D. and Ellis, A. (2005). Effective implementation of e-learning: a case study of the Australian army. J. Workplace Learn.17 (5/6), 385–397.
Norwegian Agency for Quality Assurance (NOKUT), 2006, Criteria for Evaluation of Universities and Colleges: Quality assurance system for business e ducation(in Norwegian).
Oblinger, D. G. and Oblinger, J. L. (2005).Educating the Net Generation http://www.educause.edu/ir/library/pdf/pub7101.pdf.
Ohno, T. (1988).The Toyota Production System: Beyond Large-Scale Production, Productivity Press, Portland, OR.
Oliver, M., & Trigwell, K. (2005). Can'Blended Learning'Be Redeemed? E-learning and Digital Media, 2(1), 17-26.
Osguthorpe R. T., & Graham, C. R. (2003).Blended learning environments definitions and directions.The Quarterly Review of Distance Education.4(3), 227-233.
Ossiannilsson, E. (2011). Findings from European benchmarking exercises on e-learning: value and impact. Creative Education, 2(03), 208.
Ossiannilsson, E. S. I. (2012). Quality enhancement on e-learning. Campus-Wide Information Systems, 29(4), 312-323.

Owlia, M.S., & Aspinwall, E.M. (1996). A framework for the dimensions of quality in higher education. Quality Assurance in Education, 4(2), 12–20.
Owlia, M.S., & Aspinwall, E.M. (1997). TQM in higher education – a review. International Journal of Quality and Reliability Management, 14(5), 527–543.

Ozkan, S., Koseler, R., & Baykal, N. (2009). Evaluating learning management systems: adoption of hexagonal e-learning assessment model in higher education. Transforming Government: People, Process and Policy, 3(2), 111-130.
Palloff, R. M., & Pratt, K. (2007). Building online learning communities: Effective strategies for the virtual classroom. San Francisco: Jossey-Bass.
Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1994). Alternative scales for measuring service quality: a comparative assessment based on psychometric and diagnostic criteria. Journal of retailing, 70(3), 201-230.
Pedrosa de Jesus*, H., Almeida, P. C., & Watts, M. (2004). Questioning styles and students' learning: Four case studies. Educational Psychology, 24(4), 531-548.
Pegler, C. (2005). Objects and issues—a Sunday supplement view of continuing professional development in higher education. Open Learning: The Journal of Open, Distance and e-Learning, 20(1), 51-64.Quality Assurance Agency (1997), Subject Review Handbook, October 1998 to September 2000, December, Quality Assurance Agency.
Ramsden, P. (1992). Learning to teach in higher education. London, England: Routledge.
Ramsden, P. (2003). Learning to Teach in Higher Education (2nd ed.). London; New York
Rao, R. V., & Parnichkun, M. (2009). Flexible manufacturing system selection using a combinatorial mathematics-based decision-making method.*International Journal of Production Research*, *47*(24), 6981-6998.
Report from the Swedish Agency for Higher Education of May 2008" E-learning quality Aspects and criteria for evaluation of E-learning in higher education" Published by the Swedish National Agency for Higher Education 2008.
Riffell, S., & Sibley, D. (2005). Using web-based instruction to improve large undergraduate biology courses: An evaluation of a hybrid course format.Computers & Education, 44(3), 217–235.
Robson, C. (2002). *Real word research*. Oxford: Blackwell.
Roscoe, D. D. (2012). Comparing Student Outcomes in Blended and Face-to-Face Courses. Journal of Political Science Education, 8(1), 1-19.
Rose, R., & Ray, J. (2011, July). Encapsulated Presentation: A New Paradigm of Blended Learning. In The Educational Forum (Vol. 75, No. 3, pp. 228-243). Taylor & Francis Group.
Rothblatt, S. (2006). How élite? *Oxford Review of Education*, *32*(1), 127-145.
Rovai, A. P. (2004). A constructivist approach to online college learning. *The Internet and Higher Education*, *7*(2), 79-93.
Rovai, A. P., & Jordan, H. M. (2004). Blended learning and sense of community: A comparative analysis with traditional and fully online graduate courses. International Review of Research in International Review of Research in Open and Distance Learning. Retrieved August 5, 2004 from http://www.irrodl.org/content/v5.2/rovaijordan.html, p13.

Rowley, K., Bunker, E., & Cole, D. (2002). Designing the right blend combining online and onsite training for optimal results. Performance Improvement, 41(4), 26-36.

Rungtusanatham, M., Ellram, L. M., & Siferd, S. P. (2004). Toward a typology of business education in the internet age. Decision Sciences Journal of Innovative Education, 2(2), 101–120.

Sadler*, D. R. (2005). Interpretations of criteria-based assessment and grading in higher education. *Assessment & Evaluation in Higher Education*, *30*(2), 175-194.

Safari, H., Abdollahi, B., & Ghasemi, R. (2012). Canonical correlation analysis between people criterion and people results criterion in EFQM model. Total Quality Management & Business Excellence, 23(5-6), 541-555.

Sahney, S., Banwet, D.K., & Karuness, S. (2004). Conceptualizing total quality management in higher education. The TQM Magazine, 16(2), 145–159.

Sakthivel, P. B., Rajendran, G., & Raju, R. (2005). TQM implementation and students' satisfaction of academic performance. *The TQM Magazine*, *17*(6), 573-589.

Salmon, G. (2000). E-Moderating: The Key to Teaching and Learning Online. London: Kogan Page.

Salmon, G. (2004). E-Moderating: The key to online teaching and learning (2nd ed.). London: Taylor & Francis.

Sankaran, S. R., & Bui, T. (2001). Impact of Learning Strategies and Motivation on Performance: A Study in Web-Based Instruction. *Journal of Instructional Psychology*, *28*(3), 191-98.

Saunders, M., Lewis, P. and Thornhill, A. (2009), Research Methods for Business Students, Pearson Education, London.

Schmidt, M. J., & Hollensen, S. (2006). *Marketing research: An international approach*. Pearson education.

Schneider, D., Synteta, P., & Frété, C. (2002, September). Community, Content and Collaboration Management Systems in Education: A new chance for socio-constructivist scenarios. In *Proceedings of the 3rd Congress on Information and Communication Technologies in Education* (pp. 175-184.

Schniederjans, M. J., & Kim, E. B. (2005). Relationship of student undergraduate achievement and personality characteristics in a total web-based environment: An empirical study. Decision Sciences Journal of Innovative Education, 3(2), 205–221.

Schreurs J.,Moreau R.(2006). The EFQM self-assessment model in e-learning quality management. In Proceedings of Conference EDEN2006 Wenen 15-17 June 2006. Pages 233-238; ISBN 963 06 0063 3

Schreurs, J. (2008). TQM in e-Learning: a Self-assessment Model and Questionnaire.Science, s 1, 358–363.

Schrire, S. (2006). Knowledge building in asynchronous discussion groups: Going beyond quantitative analysis. *Computers & Education*, *46*(1), 49-70.

Schroeder, R. G., Linderman, K., Liedtke, C., & Choo, A. S. (2008). Six Sigma: definition and underlying theory. *Journal of operations Management*, *26*(4), 536-554.

Scott, B. (2001). Conversation theory: A constructivist, dialogical approach to educational technology. Cybernetics & human knowing, 8(4), 25-46.
Senge, P. M. (2002). The leader's new work.service quality and customer satisfaction: a factor specific approach", Journal of Services.September.
Sevgi Ozkan, Refika Koseler, Nazife Baykal, (2009),"Evaluating learning management systems: Adoption of hexagonal e-learning assessment model in higher education", Transforming Government: People, Process and Policy, Vol. 3 Iss: 2 pp. 111 – 130.
Seyed-Hosseini, S. M., Safaei, N., & Asgharpour, M. J. (2006). Reprioritization of failures in a system failure mode and effects analysis by Decision Making Trial and Evaluation Laboratory technique. Reliability Engineering and System Safety, 91(8),872–881.
Shanian, A.; Savadogo, O. 2009. A methodological concept for material selection of highly sensitive components based on multiple criteria decision analysis, Expert Systems with Applications36 (2): 1362–1370. http://dx.doi.org/10.1016/j.eswa.2007.11.052
Sharpe, R., Benfield, G., Roberts, G., & Francis, R. (2006). The undergraduate experience of blended learning: A review of UK literature and practice. Retrieved 1 June, 2008 from http://www.heacademy.ac.uk/projects/detail/lr_2006_sharpe
Shee, D. Y., & Wang, Y. S. (2008). Multi-criteria evaluation of the web-based e-learning system: A methodology based on learner satisfaction and its applications. Computers
Shepard, L. A. (2000). The role of assessment in a learning culture. Educational researcher, 4-14.
Singh, H., & Reed, C. (2001). A White Paper: Achieving Success with Blended Learning.Sioan-C, USA.
Splitter, L. J. (2009). Authenticity and constructivism in education. Studies in philosophy and education, 28(2), 135-151.Statistics, U.S. Department of Education
Stevens, J. P. (2002). Applied multivariate statistics for the social sciences (4th Ed.).London: Lawrence Erlbaum Associates.
Sthapornnanon, N., Sakulbumrungsil, R., Theeraroungchaisri, A., & Watcharadamrongkun, S. (2009). Social constructivist learning environment in an online professional practice course. American journal of pharmaceutical education, 73(1).
Stracke, C. M. (2006a). Process-oriented Quality Management. In Pawlowski J. & Ehlers, U. (Eds.) European Handbook on Quality and Standardisation in ELearning. Berlin: Springer, 79-96.
Stracke, C. M. (2006b). Interoperability and Quality Development in e-Learning. In Proceedings of the Asia-Europe e-Learning Colloquy. Seoul: e-ASEM.
Stracke, C. M. (2010). Quality development and standards in learning, education, and training: adaptation model and guidelines for implementations.*Информатизация образования и науки [= Информике (Informika), ISSN 2073-7572]*, *7*(3), 136-146.

Stracke, C. M., & Hildebrandt, B. (2007). Quality Development and Quality Standards in e Learning: Adoption, Implementation, and Adaptation. In*World Conference on Educational Multimedia, Hypermedia and Telecommunications* (Vol. 2007, No. 1, pp. 4158-4165).

Strang, K. D. (2010). Education balanced scorecard for online courses: Australia and us best-practices. Journal of Cases on Information Technology, 12(3), 44–60.
Sullivan, P. (2001). Gender differences and the online classroom: Male and female college students evaluate their experiences. Community College Journal of Research and Practice, 25, 805–818.

Sun, H. (1999). Diffusion and contribution of total quality management: an empirical study in Norway. *Total Quality Management*, *10*(6), 901-914.
Sun, P.C., Tsai, R.S., Finger, G., Chen, Y.-Y. and Yeh, D. (2008), "What drives a successful e-learning? An empirical investigation of the critical factors influencing learner satisfaction", Computers & Education, Vol. 50 No. 4, pp. 1183-202.
Sureshchander, G.S., Rajendran, C. and Anatharaman, R.N. (2002), "The relationship between

Swan, K., Garrison, D. R., & Richardson, J. C. (2009). A constructivist approach to online learning: the Community of Inquiry framework. In C. R. Payne (Ed.), Information Technology and Constructivism in Higher Education: Progressive Learning Frameworks (pp. 43−57). Hershey, PA: IGI Global.
Swedish National Agency for Higher Education, E-learning Quality Aspects and Criteria for Evaluation of E-learning in Higher Education. Stokholm: NAHE, 2008.
Tabor, S. (2007). Narrowing the distance: Implementing a hybrid learning model for information security education. The Quarterly Review of Distance Education, 8(1), 47-57.
Tamura, H., & Akazawa, K. (2005). Structural modeling and systems analysis of uneasy factors for realizing safe, secure and reliable society. Journal of Telecommunications and Information Technology, 3, 64–72.

The European Centre for Strategic Management of Universities (ESMU). (Eds) (2008a), *Benchmarking in European Higher Education. Findings of a Two-Year EU Funded Project*, ESMU, Brussels.

The European Centre for Strategic Management of Universities (ESMU). (Eds) (2008b), *A Practical Guide. Benchmarking in European Higher Education*, ESMU, Brussels.
The Sloan Consortium, "Blended Learning: Research Perspectives",edited by A. G. Picciano and C. D. Dziuban, 2007.
The Swedish National Agency for Higher Education (NAHE) (2008), *E-Learning Quality: Aspects and Criteria*, Högskoleverket, NAHE, Stockholm
Thomas, M., & Thomas, H. (2012). Using new social media and Web 2.0 technologies in business school teaching and learning. Journal of Management Development, 31(4), 358-367.

Thurlow, C., L. Lengel and A. Tomic (2004). Computer Mediated Communication: Social Interaction and the Internet. Sage Publications Ltd: London.

Thurmond, V. A., Wambach, K., & Connors, H. R. (2002). Evaluation of student satisfaction:

Determining the impact of a web-based environment by controlling for student
TOPSIS Approach for Ranking Consulting Firms. Life Science Journal, 10(1).

Triantaphyllou, E., & Sánchez, A. (1997). A Sensitivity Analysis Approach for Some Deterministic Multi-Criteria Decision-Making Methods*. *Decision Sciences*, *28*(1), 151-194.
Turskis, Z., & Zavadskas, E. K. (2010). A new additive ratio assessment (ARAS) method in multicriteria decision-making. Technological and Economic Development of Economy, (2), 159-172.
Turskis, Z., & Zavadskas, E. K. (2011). Multiple criteria decision making (MCDM) methods in economics: an overview. Technological and economic development of economy, (2), 397-427.
Tzeng, G. H., Chiang, C. H., & Li, C. W. (2007). Evaluating intertwined effects in e-learning programs: A novel hybrid MCDM model based on factor analysis and DEMATEL. Expert Systems with Applications, 32(4), 1028–1044.
Tzeng, G. H., Lin, C. W., & Opricovic, S. (2005). Multi-criteria analysis of alternative-fuel buses for public transportation. Energy Policy, 33(11), 1373–1383.
UNESCO (2004). United Nations Educational, Scientific, and Cultural Organization (UNESCO) Education Digest: Comparing education statistics across the world.
UNESCO (2009), “Bonn Declaration”, available at: www.esd-world-conference-2009.org/University - INLEI Project. Available from http://www.sfeuprojects.org.uk/inlei/University. International Journal of Engineering Education, 14(2), 105–118.
Valiathan, P. (2002). Blended learning models. Learning Circuits, Retrieved October 17, 2009 from http//www.learningcircuits.org/2002/aug2002/valiathan.html.
Van Damme, D. (2004). VIII. Standards and Indicators in Institutional and Programme Accreditation in Higher Education: A Conceptual Framework and a Proposal. Studies on Higher Education, 127.
Varlamis, I., Apostolakis I. (2010). A framework for the quality assurance of blended e-learning communities. In proceedings of the 14th Annual KES Conference, 8-10 September, 2010, Cardiff, Wales, UK. In: Setchi et al. (Eds.): KES 2010, Part III, LNAI 6278. Springer-Verlag, Berlin Heidelberg.
Vaughan, N. (2007). Perspectives on blended learning in higher education. International Journal on E-Learning. 6(1), 81-94.
Venkatrama, N. (1989). Strategic orientation and business enterprises: the construct, dimensionality and measurement.Management Science, 35(8), 942–962.
Venkatraman, S. (2007). A framework for implementing TQM in higher education programs. *Quality Assurance in Education*, *15*(1), 92-112.

Verkroost, M. J., Meijerink, L., Lintsen, H., & Veen, W. (2008). Finding a balance in dimensions of blended learning. International Journal on E-learning, 7(3), 499-522.
Vygotsky, L.S. (1935). Umstvennoe razvitie detei v protsesse obuchenia. Moscow - Leningrad. Gosudarstvennoe Uchebno-pedagogicheskoe izdatelstvo.
Waits, T. & Lewis, L. (2003). Distance Education at Degree-Granting Postsecondary Institutions: 2000-2001(NCES 2003-017). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

Wenger, E. (1998). Communities of practice: Learning, meaning, and identity. Cambridge: Cambridge University Press.
Whittington, S. (2003). Differences in teacher efficacy related to career commitment of novice agriculture teachers. DIFFERENCES, 20(1).
Wiklund, P. S., & Wiklund, H. (1999). Student focused design and improvement of university courses. *Managing Service Quality*, *9*(6), 434-443.
Wilson, B. G. (Ed.). (1996). *Constructivist learning environments: Case studies in instructional design*. Educational Technology.
Wink, J. & Putney, L. G. (2001). A vision of Vygotsky. Toronto, ON: Allyn and Bacon
Wu, J. P., Tsai, R. J., Chen, C. C., & Wu, Y. C. (2006). An integrative model to predict the continuance use of electronic learning systems:hints for teaching. International Journal on E-Learning, 5(2), 287–302.20 P.-C. Sun et al. / Computers & Education xxx (2007) xxx–xxx
Wu, W. W., & Lee, Y. T. (2007). Developing global managers' competencies using the fuzzy DEMATEL method. Expert Systems with Applications, 32(2), 499–507.
Yang, Y. P. O., Shieh, H. M., Leu, J. D., & Tzeng, G. H. (2008). A novel hybrid MCDM model combined with DEMATEL and ANP with applications.*International Journal of Operations Research*, *5*(3), 160-168.
Yazon, J. M. O., Mayer-Smith, J. A., & Redfield, R. J. (2002). Does the medium change the message? The impact of a web-based genetics course on university students' perspectives on learning and teaching. Computers & Education, 38(1), 267-285.
Yunus, Y., & Salim, J. (2008, August). Framework for the Evaluation of E-learning in Malaysian Public Sector from the pedagogical perspective. InInformation Technology, 2008. ITSim 2008. International Symposium on (Vol. 3, pp. 1-8). IEEE.
Zairi, M. and Ahmed, P.K. (1999), "Benchmarking maturity as we approach the millennium", Total Quality Management, Vol. 10 Nos 4/5, pp. 810-6
Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker Jr, J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. Information & Management, 43(1), 15-27.
Zou, Z. H., Yun, Y., & Sun, J. N. (2006). Entropy method for determination of weight of evaluating indicators in fuzzy synthetic evaluation for water quality assessment. *Journal of Environmental Sciences*, *18*(5), 1020-1023.

Appendix

Participant Invitation Letter

(Questionnaires)

Dear Participant,

Re: Development of an assessment framework for a blended learning environment in TQM perspective in the field of higher education

You have been selected to take part in this study of Development of an assessment framework for a blended learning environment in TQM perspective in the field of higher education. This is a survey being conducted as part of PhD study at the University of Salford. By drawing on your answers, I plan to develop a framework that can be used to assess the blended learning environment in TQM perspective. This will further provide information that will help the companies to enhance their current practices.

Participation in this questionnaire is voluntary and you may chose to withdraw at any time. Your individual answers will be treated in confidence and the responses from all the completed questionnaires will be aggregated for use in the research report. If you would like to receive a summary of the research findings, please provide your contact details at the end of the questionnaire and these will be shared after the data has been aggregated and analyzed. Should you wish to withdraw at any stage, your responses will be destroyed immediately.

All data will be password protected and will be kept in a secure place by the researcher. This data will be destroyed within 2 years.

Please complete the questionnaire. If you require any further information or clarification, please do not hesitate to contact researcher, vandanasavara@hotmail.com via email.

I appreciate your kind co-operation in this matter, and look forward to receiving your input. Please sign below to acknowledge you are happy to participate and are satisfied with the measures taken by the Researcher.

Signed:_____________________________________

Date:___________________

Participant Information Sheet
(Questionnaires)

"Development of an assessment framework for a blended learning environment in TQM perspective in the field of higher education"

What is the purpose of the study?

The purpose of this survey is to identify the existing levels of quality assessment, through discussion with practitioners of quality control and assurance standards in higher education field.

Why have I been invited?

You have been invited to participate in this research as you are part of the blended learning environment.

Do I have to take part?

It is your independent decision. It is really appreciated if you participate and you are free to withdraw at any time of this study. You need not provide the reason.

What will happen to me if I take part?

- Your identity remains anonymous and strictly confidential.
- All publications of data will be written in a way so as to cover your identity.
- Data will be stored in a secured PC (password protected) and then will be destroyed when it's no more needed.

What will I have to do?

You will be asked to sign a consent form to show that you agreed to take part. Further, you will be required to fill the questionnaire.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to me; I will attend your questions. If you remain unhappy and wish to address formally you can do this through my supervisor: marif@salford.ac.uk

Will my taking part in the study be kept confidential?

- All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves your organisation will have your name and address removed so that you cannot be recognised.

- Collected data will be stored electronically on a password protected computer, accessed only by me.
- Procedures for handling, processing, storage and destruction of data match the principles in the Data Protection Act 1998.
- The data is not to be used for future studies.
- Collected data will be stored and archived. After that, data will be deleted.

What will happen if I don't carry on with the study?

If you withdraw from the study all the information and data collected from you, to date, will be destroyed and your name removed from all the study files

What will happen to the results of the research study?

The results of the study in which you are involved in will be made available on your request.

Further information and contact details:

Signed

[……………………]

Participant Consent Form
(Questionnaire)

Development of an assessment framework for a blended learning environment in TQM perspective in the field of higher education

Name of Researcher: **[Vandana Savara]**

Name of Supervisor: **[Prof. M. Arif]**

Please tick the appropriate boxes	Yes	No
Taking Part		
I have read and understood the project information sheet.	☐	☐
I have been given the opportunity to ask questions about the project.	☐	☐
I understand that my taking part is voluntary; I can withdraw from the study at any time and I do not have to give any reasons for why I no longer want to take part.	☐	☐
I agree to take part in this survey.	☐	☐
Use of the information I provide for this project only		
I understand my personal details such as phone number and address will not be revealed to people outside the project.	☐	☐
I agree for the data I provide to be archived at the UK Data Archive.2	☐	☐
I understand that other genuine researchers will have access to this data only if they agree to preserve the confidentiality of the information as requested in this form.	☐	☐
I understand that other genuine researchers may use my words in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form.	☐	☐

Name of participant: ....

Signature: .... Date: ....

Participant Recruitement Letter
(Questionnaire)

Dear Participant,

You have been approached to participate in the recruitment process of a research survey project entitled: Development of an assessment framework for a blended learning environment in TQM perspective in the field of higher education

The purpose of this survey is to identify the existing levels of quality assessment, through discussion with practitioners of quality control and assurance standards in higher education field . The data obtained from this survey will provide concrete information for further stages of research where a frame work will be developed to assess for a blended learning environment in TQM perspective in the field of higher education. The survey is in a form of questionnaire and it will take approximately 15 minutes to complete. There are no identified risks from participating in this research and it is completely voluntary and you may refuse to participate without consequence.

Your rule is to help approaching potential participants on behalf of myself. This will require the followings:

- To pass on the Participant Invitation Letter and the Participant Information Sheet to the targeted sample meeting the study criteria, in terms of participants' type of industry they works in
- To ask participants who are willing to take part in this survey to sign in the Participant Consent Form
- To ask participants to fill in the questionnaire, after signing the Consent Form

I hope you choose to take part and participate in the recruitment process.If you are willing to participate, could you please confirm that in writing and by sending your confirmation to my email provided below. Please don't hesitate to contact me for any further information.

Sincerely yours,

Signed

[…………………….]

Enclosed:

- Participant Invitation Letter
- Participant Information Sheet
- Participant Consent Form

Questionnaire

FACTORS NECESSARY FOR ASSESSMENT OF BLENDED LEARNING ENVIRONMENT IN TQM (TOTAL QUALITY MANAGEMENT) PERSPECTIVE

Blended learning is a combination of face to face and on line learning, whereas blended learning environment is a combination of physical and IT enhanced environment.

Guide:

1. **Please respond by ticking the box or drawing a circle around the number that best represents your view.**
2. **All of your responses will be confidential; only summary statistics will be reported.**
3. **On a point scale of 1 to 5, rate each variable, how it impacts the success or failure of blended learning; 5 being very high , 4 high, 3 medium, 2 low and 1 not at all.**

---

1. About age group
   - ❒ 18-22 years
   - ❒ 22-30 years
   - ❒ 30-40 years
   - ❒ 40-50 years
   - ❒ 50+
2. About Gender
   - ❒ Male
   - ❒ Female
3. About l Qualification
   - ❒ GCSE/High School
   - ❒ Bachelors Degree
   - ❒ Masters Degree
   - ❒ PhD
4. How many years have you been studying in blended learning environment?
   - ❒ 1-2 Years
   - ❒ 2- 3 Years
   - ❒ 3+ years

Pedagogical Factor						
	Variable	1-Not at all	2-Low	3-Medium	4-High	5-Very high
5	Right blend of face to face and on line learning activities help in achieving the desirable learning outcomes.					
6	A well defined course structure improves learner's performance where course structure includes List of activities Schedule of activities Purpose of activities Mode of activities(online/offline)					
7	Engagement and interest of learners can be maximised by involving them into real world, problem based learning activities.					
8	A well explained content which avoids political, ethical and legal issues enhances quality of a blended learning course.					
9	The appropriate use of delivery methods (multimedia* and internet tools) significantly influences learning in blended learning environment.					
10	Personalisation of course content and course structure according to the learner's needs and styles improves learning in blended learning environment.					
11	Qualification and experience of tutor maximise the learning process in blended learning course.					
12	Support of tutor helps learner to achieve the learning goal with ease.					
13	Face to Face discussion of student's progress improves student's performance and satisfaction.					
Technological Factors						
14	An attractive, fully modernised technology equipped infrastructure adds value in quality learning experience.					
15	Creation of user friendly environment for learner by providing adequate technical components (synchronous*and asynchronous* modes of communication) helps in effective learning.					
16	Ease of use of learning management system (Blackboard/Moodle) helps in effective learning.					
17	An adequate support system helps in providing various services (e- library, online- orientation and experts online) efficiently for effective learning .					
18	Reusability of content for various courses brings sustainability in the learning environment.					
19	Availability of Communication services (24 times 7 Broadband connections) help increase popularity of blended learning.					

20	Prior knowledge of computers helps tremendously in adoption of blended learning.					
Social Factors						
21	Feeling of Isolation in blended learning environment can be harmful for learner's performance.					
22	Lack of communication in blended learning course results in poor learning and dissatisfaction.					
23	Effectiveness of interactions (student-content, student-teacher and student-student) improves quality of learning in blended learning environment.					
24	Collaboration of various universities in blended learning environment exposes learner to an international experience.					
25	Feature of Social networking in blended learning helps in getting connected to the real world.					
26	Reduction of carbon emission and solving of commute and traffic problems are easily achievable by adopting blended learning environment.					
Organisational factor						
27	Retention rate can be improved significantly by providing more flexibility in terms of place, time, pace and price of course in blended learning environment.					
28	Awarding an authoritative and valid degree / diploma for a blended learning course promotes its popularity and adoption.					
29	Lack of sufficient funds and resources affect the quality of learning badly.					
30	Strong organisational leadership in blended learning environment motivates people for better performance.					
31	Clearly defined policies and procedures in a blended learning environment improve performance of all involved in teaching and learning.					
32	Resistance to embrace change by stakeholders (both learner and management) results in poor quality of blended learning.					
Evaluation and Assessment Factor						
33	Prompt and continuous feedback help learner to motivate and learn effectively.					
34	Learner's ownership is strongly facilitated through self assessment in blended learning environment.					
35	Adoption of blended learning course by masses would result in positive return on investments. (Return on investments means benefits minus costs).					
36	Blended learning environment promotes formal and informal kind of assessment and its evaluation.					

37	Evaluation of a blended learning environment by international quality standards promotes quality of learning.					
38	Please highlight one feature of blended learning which has benefitted you the most and one which you think, needs to be introduced in future.					

Glossary: *Synchronous – Web conferencing, Virtual class room, Life tutors, live text messaging, e-meetings.

*Asynchronous – Documents and web page, assignment, survey, resources, job aids, electronic performance support system and discussion forums.

* Multi media – Text and Graphics, Audio Streaming (eg. Real Audio), Video Streaming Time), Links (Hypertext links, Hypermedia Links, 3-D links, Image maps etc.)