PERFORMANCE IMPROVEMENT OF TECHNICAL AND VOCATIONAL EDUCATION IN THE KINGDOM OF BAHRAIN

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ABSTRACT

This study is directed at improving quality of graduates coming out from the Technical and Vocational Education (TVE) system in Bahrain.The aim of TVE system is to equip the students with the skills, knowledge and work ethic required for various industries, such as electrical, electronic, telecommunications, building services, mechanical engineering and computer technology. The TVE system is a two-tier system of education comprising SBL (containing specialised technical modules delivered in the school environment) and WBL (including work placement periods) intended to equip the students/graduates with cognitive, affective and psychomotor skills essential for their future careers.

Recent TVE studies have indicated that a gap exists between the students' skills acquired during SBL and WBL study and the skills required by industrial companies in Bahrain. A novel employability skills model was developed based on extensive literature survey and exploratory studies conducted by the researcher. The skills gap was determined through quantitative and qualitative analysis of the responses of the stakeholders to Questionnaire 1. Furthermore, to interlink employability skills requirements with teaching and learning provisions within TVE, the researcher has integrated two-dimensional (2D) models for cognitive, affective and psychomotor domains within the existing provisions. For the above purpose a new 2D model for affective domain skills has been developed. With an aim to improve teaching and learning provisions, the correlation between the existing approaches of teaching and learning practised in TVE educational environment with students' learning styles was examined using Questionnaire 2. All the above was used for structuring learning activities in engineering courses so that a better match between the employability skills model and skills taught during SBL and WBL could be achieved.

To maximise the output from TVE system, a novel SWT (SBL-to-WBL Transition) module was designed and developed. This was to ensure that TVE students receive the necessary training required by industry before they go in work placement (included in WBL programme) which would enable them to perform at a very high level; within the industrial environment. The module design was based on the user-centered approach and included necessary elements to satisfy the requirements of the novel employability skills model and 2D models for cognitive, affective and psychomotor domains. The developed SWT module contained five case studies which were related to real work examples. The learning activities included, challenged the students to recognise, make informed responses, and work comfortably with the diverse requirements of WBL environment. The user evaluation of the proposed e-learning package was done by the students and teachers who completed Questionnaire 3.

Based on the above a new quality framework for online courses was developed. The modified framework extends the existing information quality frameworks by incorporating features associate with pedagogical and technological contexts. The framework would be useful in determining adequacy of the new SWT module in providing workplace proficiencies, preparing TVE students for work placement, providing effective teaching and learning methodologies, integrating innovative technology in the process of learning, meeting modern industrial needs, and offering a cooperative learning environment for TVE students.

The proposed SWT module represents a major contribution to the improvement of TVE system in Bahrain because it challenges students and teachers to be capable of recognising, making informed response towards, and working comfortably with the diversity they encounter in WBL environment.

DECLARATION

I declare that this thesis is my own investigation, and is not being concurrently submitted in candidature for any other degree.

Mohamed A. Alseddiqi

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF FIGURES IN APPENDICES

LIST OF TABLES IN APPENDICES

LIST OF ABBREVIATIONS

EECs	Electrical and Electronic Courses
EEE	Electrical and Electronic Engineering
EDB	Economic Development Board
HR	Human Recourses
ICT	Information and Communication Technology
MOE	Ministry of Education
LA	Affective Skills Learning Levels
LC	Cognitive Skills Learning Levels
LL	Learning Levels
LMS	Learning Management System
LP	Psychomotor Skills Learning Levels
LSI	Learning Styles Inventory
NCVQ	National Council for Vocational Qualifications
QAAET	Quality Assurance Authority for Education and Training
SBL	School-Based Learning
SCANS	Secretary's Commission on Achieving Necessary Skills
SPSS	Statistical Package for the Social Sciences
SWT	SBL-to-WBL Transition
TVE	Technical and Vocational Education
WBL	Work-Based Learning
2D	Two-Dimensional

CHAPTER 1- Introduction

The aim of the Technical and Vocational Education (TVE) system in the Kingdom of Bahrain is to prepare the students with the skills, knowledge and work ethic required for various industries, such as electrical, electronic, telecommunications, building services, mechanical engineering and computer technology (Quality Assurance Manual, 2008).

The TVE system objectives were introduced in the Quality Assurance Manual (2008) and presented in the points below:

- Improve the quality of graduates in meeting the requirements of the labour market.
- Contribute to Bahrain's current economic environment and provide an education linked to employment outcomes.
- Develop students' specialised vocational skills and knowledge to ensure that TVE graduates will have wider and more flexible employment opportunities.
- Enable students to apply their skills in a workplace situation.
- Provide flexibility for the ongoing development of the curriculum to meet the changing technology and practices in the labour market.
- Develop conceptual knowledge and skills to make students independent learners and able to cope better with the demands of the labour market.

The above objectives could be obtained through a two-tier educational system in Bahrain (TVE Directory, 2008), which includes school-based learning (SBL) and work-based learning (WBL):

- SBL provides students with general and specialised modules in the school environment as the foundation to success in their career.
- WBL gives students strong practical skills that make them ready for employment after graduation.

This chapter first presents the development process in the TVE system, followed by its educational structure and characteristics. Recent TVE studies have indicated that a gap exists between the students' skills acquired during SBL and WBL studies and the skills required by industrial companies in Bahrain (TVE Directory, 2008). Recently, different studies on the TVE system have been conducted and points for improvements have been proposed, however, no effective operational plans are in place to minimise this skills gap, prompting the researcher to carry out an in-depth study in the field of engineering education to improve the performance of the TVE system and contribute on its policy in Bahrain.

1.1 The Historical Development of the TVE System in Bahrain

There are seven stages in the historical development of the TVE system in the Kingdom of Bahrain (see Figure 1.1):

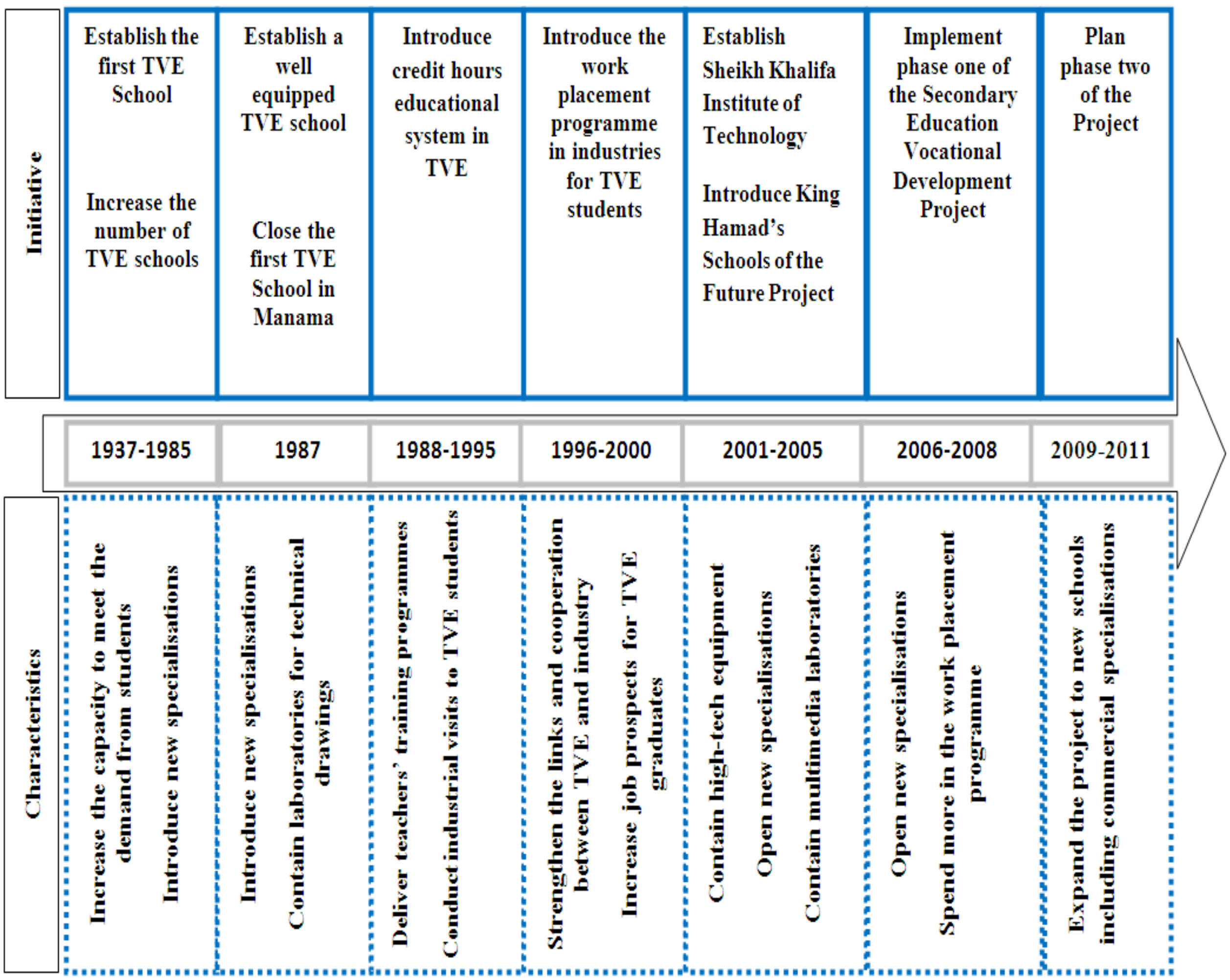

Figure 1.1: The historical development of the TVE system in Bahrain

The details about these stages are included in Table 1.1.

Table 1.1: The details of the historical development in the TVE system

Period	Details
1937 - 1985	1937 - TVE started in Bahrain when the first technical school was established to prepare craftsmen for the relevant public services and the petroleum industry. 1969 - An intermediate certificate was required for students to be accepted in TVE system. 1985 - There were four TVE institutions with new engineering specialisations (such as mechanical engineering, electrical engineering, and automotive engineering).
1986-1987	1986 - Further engineering specialisations were introduced (such as machine shop, welding and fabrication, telecommunication engineering, and instrumentation and control). 1987 - New software package was used for teaching engineering technical drawing.
1988-1995	1988 - New teacher training programmes were planned and delivered by the TVE specialists. 1995 - Student industrial visit programme was introduced for Year 3 students
1996-2000	1996 - Work placement programme was introduced. The first batches of 158 students were trained in 26 companies, over a four-week period. 2000- The programme was expanded to include all the TVE institutes.
2001-2005	A new institute of technology was opened and fully equipped with high-tech facilities. Multimedia laboratories were prepared for e-learning classes, specifically for the theoretical modules. New specialisations, namely, computer technology, printing technology and plant maintenance, were introduced to meet market requirements.
2006-2008	2006 - A joint development project for the TVE system was started between the Economic Development Board (EDB) and the Ministry of Education (MOE) to identify the problems of the existing TVE system. 2008 - The project's objectives were set (such as offer new secondary vocational education specialisations, establish a polytechnic, set policy and standards for vocational education and training, and invest in teachers' development).
2009-2011	2009 - Phase two of the development project was implemented. More time was given to the WBL programme to be six weeks 2011- The development project was expanded to include the four TVE institutions.

1.2 The Present TVE Structure

There are four TVE institutions in Kingdom of Bahrain, namely Sheikh Khalifa, Al-Jabria, Sheikh Abdulla, and Jidhafs. Figure 1.2 shows the TVE operational structure. It is a three-year educational system. Students usually enter at the age of 15, after graduating from intermediate schools. During the first, foundation year, a number of core modules are covered, such as the Arabic language, mathematics, English language, science, and basic mechanical and electrical engineering. The students join different mechanical and electrical practical sections to gain general knowledge and skills in various specialisations. On the completion of Year 1, students may join either the electrical route or the mechanical route in Year 2, according to their performance, personal interests and aptitude (TVE Directory, 2010).

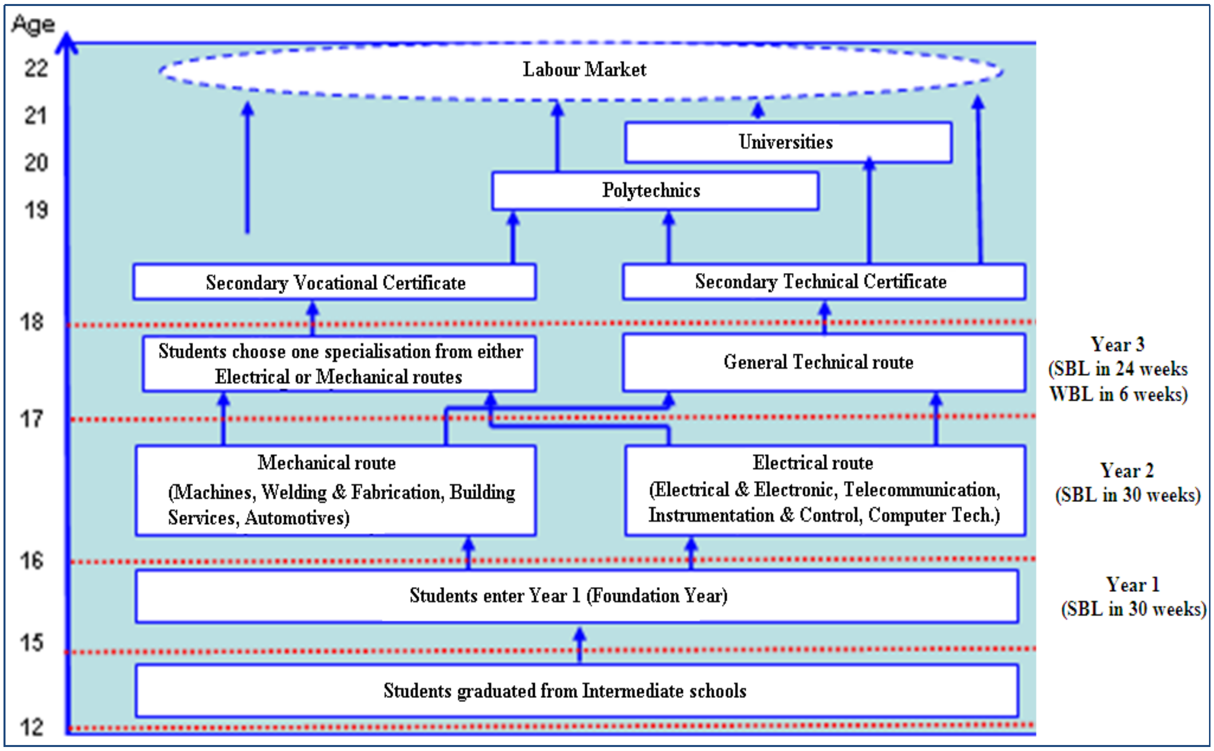

Figure 1.2: The structure of the Bahraini TVE system (Adopted from TVE Directory, 2010)

Each route in the second year contains four different engineering specialisations. The mechanical route comprises theoretical and practical modules in SBL in the following specialisations: Building Services, Machines, Welding and Fabrication, and Automotive Engineering. The electrical route comprises theoretical and practical modules in SBL in the following specialisations: Electrical and Electronic Engineering, Telecommunication Engineering, Instrumentation and Control, and Computer Technology.

In Year 3, students who have attained a sufficiently high academic standard join the Secondary Technical Certificate route. So, the technical route encourages students to develop their general knowledge to continue with further engineering studies.

Other students, who have a good practical ability, join the Secondary Vocational Certificate route and select one specific engineering specialisation (which contains more than 14 engineering specialisation, namely Electrical and Electronic, Telecommunication, Office Equipment, Control and Instrumentations, Printing Technology, Computer Technology, Plant Maintenance, Machines, Welding and Fabrication, Building Services, Automotive (Mechanical), Automotive (Electricity), Automotive (Painting), Diesel Engines). So, the vocational route enables students to obtain the practical, professional and specialised skills to qualify them to join the labour market (TVE Directory, 2008).

In addition to the SBL in Year 3, the students join a WBL programme related to their specialisation, for a period of six weeks. The programme provides actual work experience and direct contact with the labour market to the students.

1.3 TVE Characteristics

The Bahraini TVE system has three main pillars: the TVE directorate, TVE institutions, and the Bahraini labour market (see Figure 1.3). TVE specialists from the directorate and institutions review the engineering specialisations continuously in order to make changes in accordance with industry requirements. Therefore, specialisations and programmes are designed to be open-ended to enable modifications to be made and new competencies to be achieved (TVE Directory, 2008). The TVE system aims to increase the skills level of Bahrainis by developing a stronger alignment between the school curriculum and work requirements. Also, new engineering specialisations are introduced as required by industry.

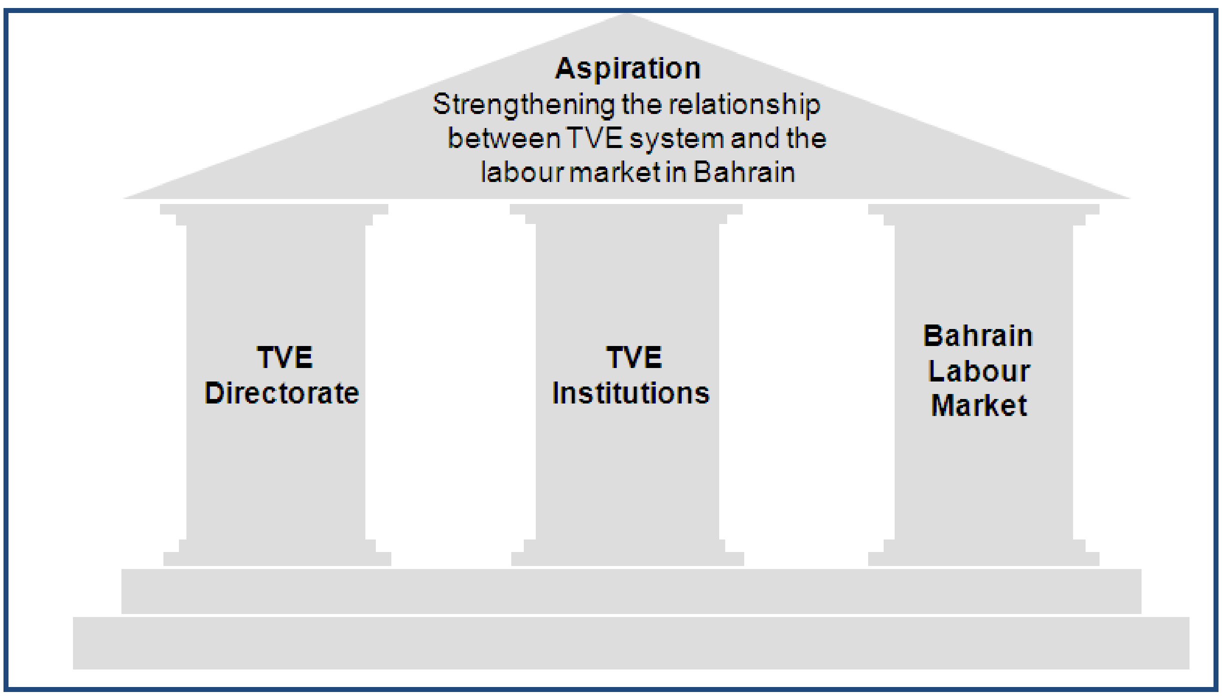

Figure 1.3: The TVE system main pillars (Adopted from EDB and TVE, 2007)

The Bahraini TVE system enrols students who have graduated from intermediate schools; those with an intermediate school certificate can join the first year of the TVE system. In the academic year 2009/2010, the total number of TVE students at the four institutes was 5,179. The total number of students was increased by 15% over the previous academic year (TVE Directory, 2010).

The TVE system is a two-tier system of education comprising SBL (containing specialised technical modules delivered in the school environment) and WBL (including work placement periods). Both tiers are intended to equip the students with cognitive, affective and psychomotor skills essential for their future careers.

School-Based Learning (SBL) - is an integral part of the TVE system; it comprises specialised technical modules and supportive modules that are to be taught in school environment. The main outcomes of SBL are to prepare the TVE students for further academic study (technical certificate) or for direct entry into the job market (vocational certificate). The outcomes are achieved through the following elements:

- Strong general education modules, such as Arabic language, Maths, English Language, and Science.
- Specialised practical modules related to students' specialisations, such as Electrical Engineering.
- More than 14 engineering specialisations for students in Year 3 vocational route.
- Competency-based assessment of practical modules.
- Introduction of new modules, such as Working with Others, Problem Solving, Quality Concepts, and Health and Safety (TVE Directory, 2006).

However, it was observed that there were a number of issues in the existing SBL (TVE Directory, 2006):

- Traditional teaching and learning methods.
- Narrow set of practical skills.
- Lack of curriculum review and development process.
- Limited ability to link theoretical content and practical applications.
- Lack of private sector involvement.
- Lack of demand-supply matching with the Bahraini market.

Some studies have suggested solutions to overcome the issues highlighted earlier in the existing SBL; for example, Boud and Feletti (1998) defined SBL as a way of constructing the teaching and learning processes in classrooms, laboratories, and workshops. Their research focused on different methods of delivering and assessing the learning materials (including traditional and competency-based education) to students, including class activities, discussions and assignments. It was also suggested that curriculum development, teaching and learning and assessment strategies should be considered to be the main areas in constructing the SBL (Finch and Crunkilton, 1999). Razzaly et al. (2008) emphasised that the centralised control vocational curriculum development did not take sufficient account of the industrial sector's needs. The curriculum content (both theoretical and practical modules) for TVE should be linked to the needs of industry and upgraded frequently. Therefore, SBL should be planned by experienced people from both the TVE system and industrial companies (Howard, 2007).

Work-Based Learning (WBL) - is also intended to equip students with skills required for their successful future careers. To meet local requirements, the WBL programme in Bahrain's TVE system places third-year students with companies and industries related to their field of specialisation for a period of six weeks. Students follow a specific training programme aimed at enriching their technical knowledge and preparing them for the labour market. In general, the WBL programme has met the desired outcomes by achieving the following aims:

- Increasing the job prospects of TVE graduates.
- Providing actual work experience.
- Receiving relevant feedback from industry regarding students' proficiencies.
- Meeting with people from different cultures.
- Understanding the work rules and regulations.

However, the following problems have been noticed in the WBL (TVE Directory, 2006):

- Six weeks is limited period for a WBL programme.
- The WBL programme has different quality standards and the WBL environment varies from one industrial establishment to another; for example, some companies have training centres while others do not.
- TVE and industry are struggling to meet the needs of a changing student population. Some companies can accommodate only a limited number of students and could not cope with an increased number.

There were different literatures that emphasise the importance of the work placement, Finch and Crunkilton (1999) defined WBL as the use of actual learning settings that enable students to perform in specific practical disciplines, such as mechanical engineering and electronic engineering. The authors identified four key stakeholder groups in engineering education: students, industry, TVE institutions, and society. The labour market should thus play a vital role in the students' learning. The Confederation of British Industry (1999) presented a study on the concept of learning in industry, confirming that students should apply skills and knowledge in a real work environment.

Stasz and Kaganoff (1997) defined WBL as a programme in which to apply the contents of the school curriculum in the workplace and to introduce new proficiencies to students. Modrakee (2005) added that the WBL programme should link the SBL learning experiences with structured WBL content in order to make the workplace an effective learning environment. Other authors, such as Hager (2004) and Billett (2008), supported this idea, saying that students should build up their own experience through involvement in real situations (problems) at work.

WBL is therefore an important aspect of the systematic and well-connected learning activities begun in SBL. The WBL scenarios underlined the variety of learning outcomes introduced in SBL as work-related knowledge, work and life literacy and understanding, and technical skills.

In summary, WBL best practices have been adapted by different TVE systems to improve the overall quality of the educational process and to meet specific industrial requirements; examples are structured workplace learning in Australia (DOE, 2005; Beckett and Hager, 2002), On the Job Training in the UK (CIPD, 2008), on-the-job learning in New Zealand (Skill New Zealand Report, 2002), and alteration learning in the Canadian TVE system (Schuetz and Sweet, 2004). Apprenticeship has been introduced in countries including the UK, Canada, the USA and Australia (Guile and Young, 1998; Hamilton and Hamilton, 1997), and work-related learning has been developed by the Quality and Curriculum Authority in the UK (QCA, 2009). WBL best practice underlines the importance of systematic and well-connected learning activities within SBL and WBL to provide a variety of learning opportunities.

1.4 Justifications of the Research

To meet with the TVE aims and objectives, the quality of the system is reviewed regularly every academic year (QAAET, 2010). The aim is to improve the TVE quality performance including both the SBL and WBL. A recent quality review was carried out to indicate whether the existing TVE system meets the labour market expectations or not (QAAET, 2010). The review indicated that a gap exists between modern industry's requirements and the work skills of the graduating students. More specifically, the factors that result in this gap have been identified as the need for up-to-date engineering courses, need for modern teaching and learning processes, and limited use of technology in learning.

The next section presents the research justifications based on various reports and studies in the TVE system (TVE Directory, 2006; EDB and TVE, 2007; QAAET, 2010; TVE Directory, 2010; MOE, 2011) and the researcher's experience being as a Teacher (taught Electrical and Electronic Engineering), an Educational Specialist (reviewed and monitored the quality assurance system in TVE and issued periodic reports on the quality of the TVE system to the educational institutions), and a Project Adviser (assisted the educational experts from UK and Australia to provide information about the existing TVE system and contributed in suggesting solutions for improvements). The relevant information is presented in the sections below:

1.4.1 Employability Skills Gap

In 2005, TVE conducted a graduate tracking survey, with the aim of discovering the destination of TVE graduates. The results indicated that only 12% of TVE graduates directly joined the labour market, 20% did not work or study and 68% joined further and higher education institutions as shown in Figure 1.4.

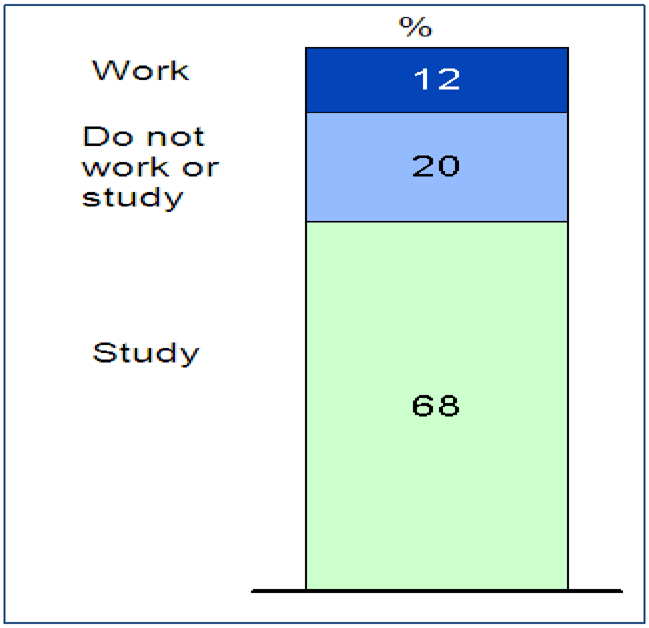

Figure 1.4: The destination of TVE graduates (Adopted from EDB and TVE, 2007)

From the survey findings, it was observed that there were a number of issues that should be highlighted:

- The TVE graduates might not be prepared efficiently to direct access to the labour market.
- Job offers to TVE graduates might not be attractive in terms of pay and prestige.
- TVE graduates might not be mature and motivated enough to enter the job market.

In 2006, the EDB and the MOE conducted a joint survey, which aimed to identify the specific industrial skills requirements. The findings showed that 50% of the industrial companies' respondents stated that there was a gap between the needs of industry and the skills that graduates acquired during their studies in the TVE system; this is shown in Figure 1.5. The respondents indicated that the TVE system did not prepare their students with the skills required for direct access to the labour market. From a skill set of 20 important skills, which included soft skills, hard skills and work-ethic skills, the respondents agreed that proficiency in English, practical experience, problem solving, work ethics and teamwork were the skills most frequently lacking in new graduates (TVE Directory, 2008).

Based on the study results, there were number of development proposals have been suggested to minimise the employability skills gap:

- Further analysis should be carried out to identify the employability skills required by the labour market.
- There is a need for a specific employability skills model. An innovative model should be developed to include the skills required by industry.
- Effective use should be made of the transition from SBL to WBL. Ryan (2001) stated that SBL and WBL could not be left as two separate elements; SBL and WBL should be correlated for appropriate theoretical and practical learning in various TVE courses. It was obvious that the workplace should support students in combining various types of knowledge and skills and should embrace SBL and WBL. Therefore, an effective connecting linkage should be available to ensure successful SBL to WBL transition. Thus, in addition to incorporating the required employability skills in the existing SBL modules and WBL programmes, SBL to WBL transition should be effectively introduced in the TVE system that students are prepared for the labour market in SBL and then join a work placement programme with the required employability skills.

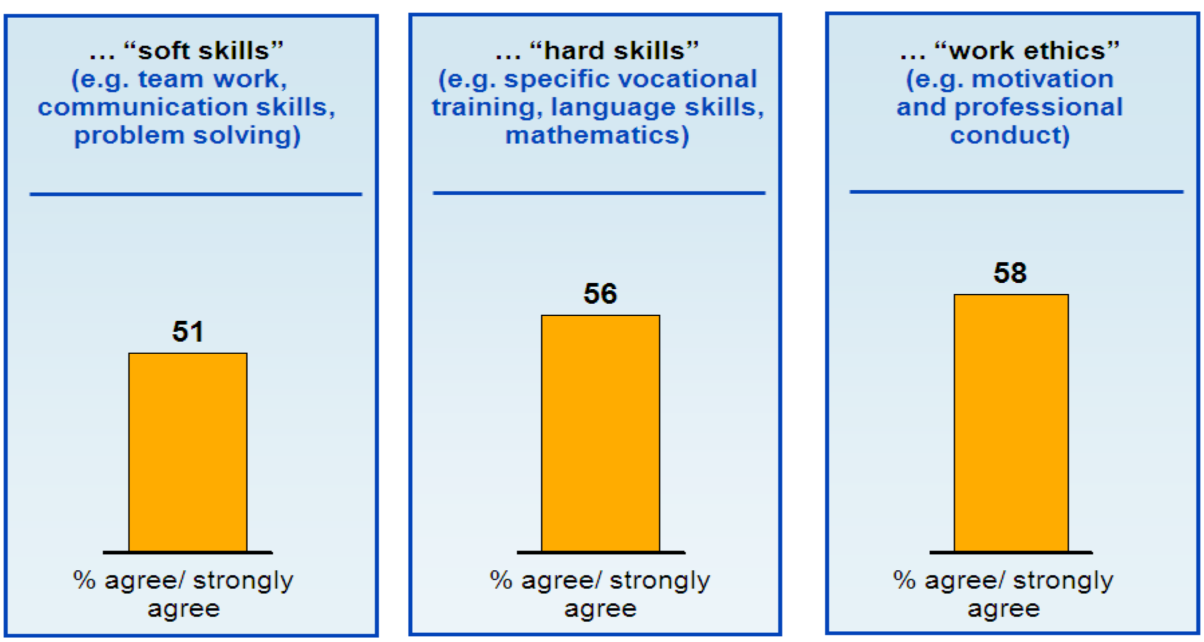

Figure 1.5: The survey results (From EDB and TVE, 2007)

1.4.2 Need for Up-to-Date Engineering Courses

The TVE policy was to review the engineering courses and training programmes continuously to meet changing industry requirements. In recent years, new engineering courses have been introduced, namely, Computer Technology, Printing Technology, and Plant Maintenance. New SBL modules have also been introduced to support these new engineering courses: Working with Others, Problem Solving, Quality Concepts, and Health and Safety.

The Quality Assurance Authority for Education and Training (QAAET) examined the quality of the engineering courses (QAAET, 2010). It was indicated that:

- Most of the teachers confirmed that the existing engineering courses had not been updated for a long time.
- The amount of information and the time allowed for delivering the existing engineering courses in SBL limits students' abilities and does not consider individual needs.
- The existing engineering courses are based on teacher-centred learning and focus on both theoretical learning in ordinary classrooms and practical applications.
- The existing engineering courses had limited ability to link theoretical content and practical applications.

The above issues have been reported extensively in the literature, and the different learning theories have been reviewed. Also, some suggestions for developing effective engineering courses with the required employability skills are considered.

1.4.3 Need for Modern Teaching and Learning Processes for Engineering Courses

In 2010, a diagnostic study was carried out to review the effectiveness of the teaching and learning processes (TVE Directory, 2010). The findings indicated that the existing teaching and learning methods took a traditional approach, which paid little attention to the motivation and feedback processes that might reflect students' academic achievements. The review also confirmed there was a shortfall between the current teaching styles and the preferred learning styles of students. It was obvious that most TVE students were not able to practise analytical thinking skills, communicate effectively with others, feel confident, or show awareness and responsibility in their behaviour (QAAET, 2010). From the diagnostic study, it was indicated that there was a need to:

- Further investigate the teaching and learning styles practised by TVE teachers and preferred by TVE students.
- Consider the individual learner's requirements in the teaching and learning processes.
- Develop the quality of teaching and learning processes, in particular through the improved training of teachers.

1.4.4 Need for Using Technology into Teaching and Learning Processes

In the mid-1980s, the concept of information technology was introduced in secondary schools in Bahrain. In order to integrate information technology throughout the process of learning, in 1987, the MOE built computer laboratories in the TVE institutions for computer technology courses. After that, learning resource centres were opened, with personal computers linked to the Internet. More recently, a project entitled 'King Hamad's School of the Future Project' was established (MOE, 2011). It aimed to:

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

It was noticed that the new technology was limited to teaching the core (theoretical) modules in SBL. The MOE integrated information technology in teaching and learning processes, mainly for core modules such as Mathematics, Science, and English Language, in both general education and the TVE system. The researcher believes that technology can also be integrated into the process of teaching and learning in the specialised modules (engineering courses) in SBL.

It was obvious that the research justifications started with employability skills requirements. To ensure that the skills requirements are considered and will be met in the future, they should be embedded in content of engineering courses with appropriate teaching and learning processes. Also, it is suggested that technology could be used for the appropriate delivery of the existing and newly designed engineering courses with the required employability skills. Finally, the quality of the process should be evaluated to meet the TVE aims and objectives.

1.5 Organisation of the Thesis

The work presented in this thesis is organised in eight chapters which provide the necessary background material and present the original work.

Chapter 1 presents the aim and objectives of the TVE system in Bahrain, the historical development, the present structure and the TVE characteristics. Also, the chapter introduces the justifications of this research.

Chapter 2 presents the conclusions of the critical appraisal of the existing publications related to employability skills models; theories and models of learning used for educational research and practice; the impact of using technology for teaching and learning processes; information quality frameworks; the development of questionnaires and analysis of answers. Also, the chapter shows the aims, objectives and the plan for this research.

Chapter 3 presents an employability skills training model which is developed considering the gap between the students' skills acquired during SBL study and the skills required by industrial companies in Bahrain. The gap is determined through quantitative and qualitative analysis of the responses to Questionnaire 1 by the teachers, industrial supervisors and HR specialists. The proposed employability skills training model aims to satisfy both the TVE (internal) objectives and industrial (external) requirements and is used to develop the SWT (SBL-to-WBL Transition) module.

Chapter 4 presents 2D model for affective domain skills which is built and 2D models for cognitive and psychomotor domains skills are reviewed. The 2D models and the employability skills training model are used for structuring learning activities in the developed SWT module.

Chapter 5 presents the correlation between the existing approaches of teaching and learning practised in TVE educational environment with students' learning styles obtained by analysing teachers and students' responses to Questionnaire 2.

Chapter 6 presents the SWT module which is designed and developed to ensure that TVE students receive the necessary training required by industry before they go in work placement (included in WBL programme). The design is performed by following the user-centered approach and based on the novel employability skills training model and 2D models for cognitive, affective and psychomotor domains. The developed SWT module contains five case studies which are related to real work examples so the students could learn for work, about work and through work.

Chapter 7 presents an evaluation quality framework which is designed to measure the effectiveness of the new SWT module with respect to pedagogical and technological contexts. The user evaluation is done by the students and teachers who have completed Questionnaire 3.

Chapter 8 summarises the salient points and draws conclusions. Also, recommendations for further work are proposed.

The next chapter presents the literature review related to employability skills models, theories and models of learning and using technology for teaching processes and information quality frameworks. The scope and objectives of this research is presented (see Section 2.7).

CHAPTER 2- Literature Review

The first section of this chapter contains a critical appraisal of employability skills models. These models are related to different vocational education systems that are mostly relevant to the TVE system in Bahrain. Then, these models are categorised using cognitive, affective and psychomotor skills criteria.

The second section presents a review of the theories and models of learning used for educational research and practice. The emphasis is on Bloom's taxonomy (Bloom, 1956), Kolb's learning styles (Kolb, 1984) and other theories which have been used in the development of questionnaires and proposed a new engineering module presented in this research.

The third section presents the publications analysing the impact of using technology for teaching and learning processes which aims to provide various modes of delivery for different learning styles preferred by TVE students.

The fourth section contains a critical appraisal of the information quality frameworks which can be used to assess the effectiveness of the learning content included in a technological system.

The final section presents a review of the issues of reliability, validity, bias and triangulation related to the development of questionnaires. Also the quantitative and qualitative methods used for data analysis from questionnaires are discussed.

2.1 Employability Skills Models

Modern industries require graduated students with enhanced employability skills, and TVE system should provide generic skills alongside technical skills, as industry needs multi-skilled employees in different engineering disciplines. Wagiran (2008) stressed that the integration of employability skills in the curriculum of TVE system would result in future employees that would have skills and knowledge to perform well in the workplace. In this way the skills gap between the workplace requirements and TVE systems (Knight and Yorke, 2003) should be minimised.

Numerous researches have attempted to explain the term "employability skills" (Hamilton and Hamilton, 1997; Knight and Yorke, 2004; Wagiran, 2008). It could be said that employability skills were a combination of core and soft skills that enable students to acquire the knowledge, skills and attitudes required by modern industry.

Curtis and Mckenzie (2001) proposed a model for national and international employability skills requirements. A report was developed by Mayer Committee (National Training Board and the Australian Education Council) to identify the required employability skills from vocational education graduates by the local and international companies in Australia. The report defined competencies as the learner's ability to transfer knowledge and skills from an educational system to a new situation such as a workplace environment. Table 2.1 shows the key competencies from Mayer model.

Table 2.1: The key competencies from Mayer model (Adopted from Curtis and Mckenzie, 2001)

Key Clusters	Key Competencies	Description
Basic skills	Management of information	How to select the useful information and present it in an appropriate way
	Communication ideas and information	How to use reading, writing, and speaking abilities Encourage in dialogues with others
Intellectual abilities	Planning and organising activities	How to make an effective use of time, arrange work priorities, and monitor work performance
	Solving problems	How to interact effectively with other people in providing solutions
	Numeracy skills	The ability to use mathematics ideas and techniques
	ICT skills	The ability to use technology
Personal attributes	Working with others	Build strong relationships with the team members

These key competencies were essential to the success of TVE graduates in the labour market. So they need to have social skills to participate effectively in the workplace environment through team work activities and also to be independent learners and use personal knowledge and skills. The model was based on the requirements of Australian companies. It was obvious that Mayer's model concentrated on knowledge skills (basic skills and intellectual abilities) and attitude skills (personal attributes). Also, the TVE graduates should also develop their psychomotor skills (including the ability to command, control machines and equipment from the work environment).

Kearns (2001) proposed an improved version of Mayer's model which was based on a survey conducted in cooperation with the Australian Industry Group. The employers' skills requirements were divided into key clusters:

- Work readiness and work habits.
- Interpersonal skills and enterprise.
- Innovation and creativity skills.
- Learning, thinking and adaptability.

It was clear that Kearn's improved version of Mayer's model incorporated the required key competencies in new clusters which have been requested by the industry.

Curtin (2004) developed the version containing "*the employability skills of the future*" which included set of skills needed by the Australian industry from vocational education graduates:

- Communication skills - Listen, understand, negotiate, empathise, persuade, and be assertive.
- Team working skills - Future planning and crisis solving.
- Problem solving skills - Creative, innovative, and efficient.
- Enterprise skills - Adaptive, strategic, and visionary.
- Planning and organising skills - Managing time and priorities, predicting, and resourcefulness.
- Self-management skills - Responsible and self-critical.
- Learning skills - Enthusiasm and open to new ideas.
- Technology skills - Effective use of technology.

Curtin's model added new competencies (team working, enterprise skills, self-management, and learning skills) which were required by the Australian industries as future employability skills. However, the model did not categorise the key competencies into key clusters as Mayer and Kearn have proposed.

Shaw and Sage (2003) presented a core skills model which was developed on the basis of a research project conducted by the National Council for Vocational Qualifications (NCVQ). This model contained the skills required from students in the 16-19 year age group. Table 2.2 shows the original version of the NCVQ core skills model in the U.K.

The students' personal competencies and intellectual abilities should be assessed in different learning settings. During the teaching and learning processes, students' knowledge abilities were measured by various learning exercises in the learning environment. The authors underlined that teaching and learning methodologies should be specified when considering the skills development for students from vocational education. This set of core skills should also be used to assess competencies which were included in the learning curriculum. Therefore, the teachers should be trained to plan, deliver, and assess the learning content in an appropriate learning environment by taking into account the above mentioned set of core skills.

Table 2.2 The NCVQ core skills model (Adopted from Shaw and Sage, 2003)

Core Skills	Description
Communication skills	Take parts in discussions Produce written materials Read and respond to written materials
Personal skills	Taking responsibility for one's own learning Working with others
Numeracy skills	The ability to use Application of numbers
ICT skills	Prepare information Use technology

Dacre and Sewel (2007) have carried out further studies and an extended version was proposed. This model included generic skills, emotional intelligence, career development learning, experience from work and life, reflection and evaluation, and self-esteem and self-confidence.

Once again these models have not explicitly included the psychomotor skills even though they are important for TVE students, graduates and industrial companies.

The Secretary's Commission on Achieving Necessary Skills (SCANS) in USA conducted a study to identify the required employability skills by the USA industry. Curtis and Mckenzie (2001) published the results and showed that the required skills can be divided into foundation skills (basic and thinking skills, personal qualities) and workplace *'know-how'* competencies (resources, information, systems, technology, interpersonal skills) (see Table 2.3.). The SCANS model incorporated personal attributes such as values and work ethics in the workplace as it was suggested by Kearns (2001). Gibb (2004) added involvement in community and business skills to this model. However, the foundation skills in SCANS model did not consider the students' prior knowledge which could influence their performance in the workplace. Also the psychomotor skills should be included in the workplace competencies.

Table 2.3: SCANS workplace model (Adopted from Kearns, 2001)

Key Cluster	Specific Skill	Description
Foundation skills	Basic skills	Reading, writing, listening, speaking, and numeracy skills
	Thinking skills	Be creative, solve problems, and take decisions
	Personal qualities	Self-management
Workplace competencies	Resources	Know how to allocate time, money, materials, space and staff
	Interpersonal skills	Work in teams, negotiate, and understand culturally diverse background
	Information	Acquire and evaluate information
	Systems	Use computer systems to socialise with others
	Technology	Apply technology in the workplace

Table 2.4 shows the comparison between the Mayer, NCVQ and SCANS employability skills models which could be categorised into three main criteria, cognitive skills, affective skills, and psychomotor skills.

Cognitive skills represent the basic knowledge proficiencies and intellectual abilities on understanding how to learn the skills which are the initial stage for high job performance. **Affective skills** are related to the psychological understanding and encouragements of attitudes, values, and ethics.

Psychomotor skills are related to the ability to convert the basic skills of knowledge and attitude into physical skills and hands-on applied and technical proficiencies. The psychomotor skills were not included as a set of skills in the reviewed models.

The comparison between the three models showed that Mayer and NCVQ models had same cognitive and affective skills (such as, numeracy, communication skills, and ICT skills). It was clear that each model was developed to bridge the gap between vocational education system and the required workplace skills by the labour market from the three countries.

Hamilton and Hamilton (1997) confirmed the importance of skills related to cognitive, affective, and psychomotor domains. They conducted a study which indicated that employers preferred graduate students with knowledge understanding (cognitive), technical skills (psychomotor), and social skills and appropriate personal attributes (affective). In addition, the technical and physical skills included in the psychomotor skills are important as students would have the opportunity to practise different technical and physical skills in SBL before they go to work placement.

Billett (2008) confirmed that the global economy has faced a number of challenges which increase the pressure on industrial companies to meet the required skills demand. Although soft skills (such as reading, writing, problem solving, team working and communication skills) were still in demand, a new skills set was also important to meet current and future market requirements. Therefore, Billett introduced the concept of cultural awareness in the workplace, to develop knowledge and behaviour in practical situations.

The extensive review had indicated that the available employability skills models could be used to benchmark the performance of students; however, they were developed for specific purpose and were not focused on the TVE system in Bahrain. The researcher suggested that further analysis should be conducted to identify the gap between the students' skills developed by studying the modules included in SBL and WBL programmes and the skills required by industrial companies in Bahrain. A new employability skills model should be developed specifically for the TVE system in Bahrain to satisfy both the TVE (internal) objectives and industrial (external) requirements.

Table 2.4: Comparison between employability skills models

Employability skills models	**Mayer key competencies model**							**NCVQ core skills model**				**SCANS workplace model**							
Key skills domain	**Management of information**	**Communication ideas and information**	**Planning and organising activities**	**Solving problems**	**Numeracy skills**	**ICT skills**	**Working with others**	**Communication skills**	**Personal skills**	**Numeracy skills**	**ICT skills**	**Basic skills**	**Thinking skills**	**Personal qualities**	**Resources**	**Interpersonal skills**	**Information**	**Systems**	**Technology**
Cognitive	x	x	x	x	x	x	x	x		x	x	x	x		x		x	x	x
Affective	x	x	x	x		x	x	x	x		x			x		x			
Psychomotor																			

2.2 Theories and Models of Learning for Educational Research and Practice

Schunk (2012) proposed that learning should involve three main criteria: learning involves change; learning endures over time; and learning occurs through experience. The criteria indicated that:

- Students learn when they do things (learning by doing).
- Students acquire new knowledge.
- Students are examined on what they want to say, write and do.
- The degree of change in a student's knowledge depends on the amount of time spent in learning processes.
- It is debatable how long changes must last to be classified as learnt, but changes that have only a brief duration do not qualify as learning.
- New experience for a student depends on the learning environment, including interaction with others.

Biggs (1999) looked at the pedagogical aspects of learning and emphasised the three themes of learning: planning the learning outcomes; defining the learning theories (for curriculum development, teaching and learning processes, and assessment strategy); and studying the usability of the learning resources. Pedagogical design should ensure that the learning outcome's contents, learning activities, teaching and learning processes, assessment methods and learning environments were effectively linked together, as shown in Figure 2.1.

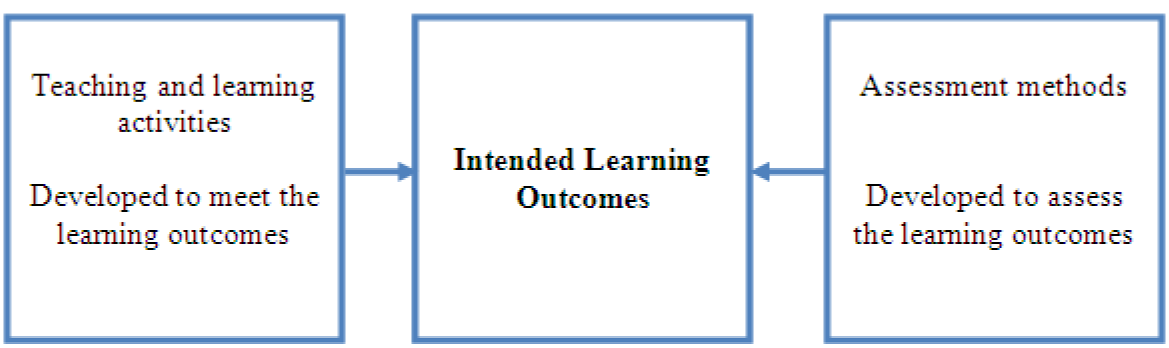

Figure 2.1: Aligning learning outcomes, teaching and learning, and assessment (From Biggs, 1999)

In the TVE system, the learning outcomes (planned activities including academic knowledge and social skills) should be tailored to the industrial requirements and should be achievable through students' interaction with the learning environment.
A JISC report (2004) underlined that learning resources should be designed to meet both internal and external objectives. For example, the engineering courses should be designed to achieve the educational goals (TVE goals) and to meet the labour market expectations (industrial companies' requirements).

The definition of learning and the importance of pedagogy were presented because they are the philosophical views behind using learning theories for educational research and practice. Thus, cognitive psychologists have considered these issues and then have examined whether existing learning theories were applicable for designing school learning courses. Schunk (2012) incorporated new personal and situational factors in the learning theories:

- Understanding the theories of how people learn, the ability to apply these theories in the teaching process is one of the initial requirements for the teaching of effective courses.
- A large number of scientists studied the mental development and the nature of learning in different ways, which provided a variety of learning theories.
- The learning theories could be defined as a method to organise a study of some variables in the learning and mental development.
- Understanding the correct theories of learning enables teachers to choose appropriate teaching strategies for effective teaching in the learning environment.

2.2.1 Cognitive Learning Theories

The cognitive psychologists who developed these theories included Brunner, Ozubl, Gagne, Piaget, Bujalski, Deans and Skinner (Seetanah et al., 2010). Cognitive learning theories focused on the acquisition of cognitive skills by building and introducing new knowledge to students during their school education. Learning was an internal mental phenomenon because it depended mainly on students' knowledge and what they should do. The mental processes organised information as follows: construction, acquisition, organisation of knowledge, storage of information, and retrieval from memory (Schunk, 2012).

Constructivist learning theory - Sherman (1995) assumed that each student could be taught any subject at any age. His theory considered that the students constructed new information from previous knowledge and their thinking skills improved through interaction with the environment. Every human being has a special vision to see the world around him/her and interprets this vision for himself/herself. Therefore, the constructivist theory identified the concept of knowledge creation which occurred through facilitating teaching and learning activities (constructive activities) during the learning process. It was indicated that constructivist learning theory considered the cognitive abilities (knowledge) of the students as a product of an individual's own experience. Then Fosnot (1996) added that knowledge should be constructed in the mind of the student and not only by being transferred from the teachers to the students.

Discovery learning theory – Fosnot (1996) also gave the student an active role in the development of information. He was interested in the concept of individual learning and learning by discovery; he found that the student should be able to formulate problems and search for alternative solutions. The objectives in Brunner's discovery theory were the transfer of knowledge to the student, the development of a positive trend towards learning, the development of skills in inquiry and discovery learning by the students, and the positive interaction with the social and the physical environment.

Gagné's theory of instruction - attempted to incorporate two main categories, namely learning outcomes and learning conditions (Smith and Ragan, 2010). Table 2.5 shows an appropriate enhancement of the process of learning which considered Gagne's theory of instruction.

The learning outcomes correspond to Bloom's taxonomy skills:

- Cognitive skills - verbal information, intellectual skill, cognitive strategy.
- Affective skills – attitude.
- Psychomotor skills – motor skills.

Also the learning outcomes had a hierarchical structure going from the simplest topics at the base towards the most complex topics at the top of the hierarchy. The theme of each level was to build on the prerequisite subjects learnt at the previous level. Gagné assumed that students should be prepared to learn within a new subject only after mastering the necessary pre-requirements. Thus, the planning of education should be concerned with identifying and arranging the necessary elements of each topic within the subject. Therefore, the teacher should consider how to construct the learning activities to teach the subject as a whole.

Table 2.5: Gagné's instructional learning theory (From Smith and Ragan, 2010)

Learning Outcomes	Example of Learning Conditions (Internal or External)
Verbal Information	Context of meaningful information
Intellectual Skills	Guidance by verbal or other means
Cognitive	Demonstration of solution by students
Attitude	Establishment of recall of respect for human model
Motor Skills	Practice of total skills; precise feedback

The learning conditions could be internal (based on prior knowledge and experience) and external (based on new instructions) to the learning outcomes. So, the acquisition of knowledge, attitude, and skills could be obtained through these conditions of learning. So the first condition mainly relied on what the students knew (internal) before they were given any learning instructions. The second condition mainly relied on what instructions were provided externally (such as verbal information from the teacher, videos, books, and online learning materials).

Piaget's cognitive learning theory - emphasised that the growth of knowledge-based description and analysis dealt with mental development. The theory is psychometric and cognitively-oriented in addressing the mental activity of knowledge (Atherton, 2011). This is a genetic epistemological learning theory; cognitive structures change through the processes of adaptation (assimilation and accommodation) and the theory is applied in teaching practice and curriculum design.

2.2.2 Bloom's Taxonomy

Professor Benjamin Bloom introduced his famous theory, Taxonomy of Educational Objectives, at the University of Chicago (Bloom, 1956). The main objective of his taxonomy was to structure a system for categorising and quantifying learning behaviour to assist in the development and assessment of educational learning. Firstly, Bloom identified the cognitive domain with six learning levels: recall data, understand, apply, analyse, synthesise, and evaluate. The original taxonomy was to classify circular objectives and test learning objectives across the six learning levels. Then, an adjusted version of the cognitive domain was produced: levels five and six (synthesis and evaluation) were replaced by evaluation and creation. Psychomotor domain addressed the skills related to practical applications (Anderson and Krathwhol, 2001). Table 2.6 contains cognitive, affective and psychomotor domains and the learning levels starting from the simplest one (for basic competencies) to higher learning levels (for more specific and complex competencies). The learning levels classification corresponded to students' ability to learn and practise a range of knowledge, attitude, and skills competencies from lower to higher learning levels. There were other systems or hierarchies devised in the educational and training world but Bloom's taxonomy still is widely applied today.

Bloom's Cognitive Domain of Learning - Even though some improvements were made to the original cognitive taxonomy, the cognitive psychologists noticed that there were limitations in this domain. The critical limitation was the assumption that the learning levels were ordered in a single dimension in a cumulative format from simple to complex behaviour (Aly, 2006). For example, applying knowledge is more complex than understanding it.

Table 2.6: The learning levels classification of Bloom's taxonomy

	Learning Domain / Learning Level	Cognitive Domain	Affective Domain	Psychomotor Domain
Lower Learning Levels	1	Recall	Receive	Observe
	2	Understand	Respond	Perform
	3	Apply	Value	Demonstrate
Higher Learning Levels	4	Analyse	Organise	Construct
	5	Evaluate	Characterise	Design
	6	Create		

To overcome these limitations, a revised version of Bloom's cognitive domain was initiated by cognitive psychologists (Anderson and Krathwohl, 2001). Figure 2.2 shows the new version containing the second dimension for cognitive domain learning activities. The aim was to develop an effective two-dimensional (2D) taxonomy for structuring cognitive domain learning content in a school setting. The new taxonomy was separating the noun and verb components into two dimensions, namely the knowledge dimension (noun aspect) and cognitive process dimension (verb aspect). For example, in developing learning objectives with respect to the two dimensions, each learning objective should include some subject matter content (noun aspect) and description of what should be done (verb aspect). The 2D model for the cognitive domain was arranged along two axes, the horizontal axis containing four categories for the knowledge dimension (noun aspect) and the vertical axis incorporating the six learning levels as the cognitive process dimension (verb aspect).

The knowledge dimension contained four categories for cognitive process, according to type of knowledge: factual, conceptual, procedural and meta-cognitive knowledge (Anderson and Krathwohl, 2001; Forehand, 2005; Aly, 2006). It was based on new cognitive and psychological educational needs (Forehand, 2005). The first three categories, factual, conceptual and procedural knowledge, were developed and incorporated after the original taxonomy by Bloom; however, they were recognised, renamed and separated in the new dimension (knowledge dimension).

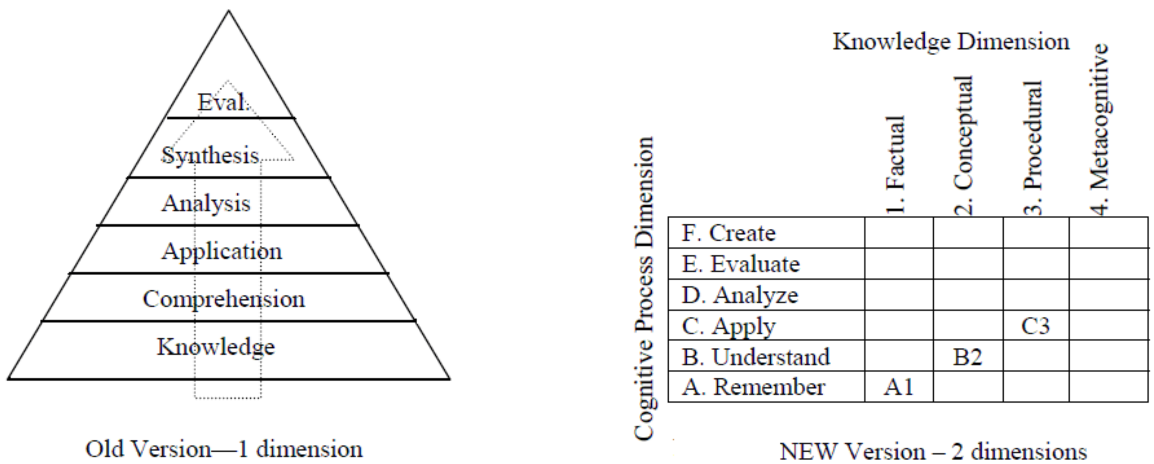

Figure 2.2: Bloom's cognitive domain and the revised version (From Pickard, 2007)

The fourth category was not presented in the original taxonomy and was added by cognitive psychologists. Pintrich (2002) clarified that the meta-cognitive category explained knowledge in general and cognitive awareness. For example, this knowledge category provided strategies for learning such as problem solving, thinking skills, and self-knowledge. With the knowledge dimension, students should be more responsible for the learning process and student-centred learning paradigms have been incorporated into the learning structure. In addition, this revised domain might be used as a framework for analysing and developing up-to-date learning resources, helping teachers and students to distinguish between objectives and learning activities, and providing an appropriate approach for teaching and learning and assessment in the TVE system.

Bloom's Affective Domain of Learning - Bloom's original classification emphasised cumulating skills which were extremely important in ensuring the sequence in the growth levels of students' affective domain competencies. This domain's objectives were to improve students' values, beliefs, emotions, and behaviours cumulatively in a learning environment (Hewitt et al., 2011). Shephard (2008) conducted a study analysing the curriculum content in an educational system. He found that the existing learning resources were designed to accommodate cognitive skills and psychomotor skills.

The affective domain, which was especially required by modern industry (Alseddiqi et al., 2009), had not been properly integrated within the learning resources. Shephard (2008) confirmed that it was possible to use Bloom's affective domain to design measurable learning activities in the same way that educators had used it in designing cognitive domain learning objectives and learning activities. The learning activities aiming to develop students' affective skills should encourage them to work in teams, share personal views, beliefs and emotions, and increased their ability and willingness to learn. However, Shephard added that some difficulties occurred in training and motivating teachers for designing learning activities for affective domain skills. Also Birbeck (2009) emphasised that teachers found it easier to teach cognitive than affective learning outcomes.

One indication of the need for increasing attention being paid to affective domain skills is the industrial requirements from TVE students, as they include work ethics such as emotional intelligence attitude. Hewitt et al. (2011) agreed with Lopez and Snyder (2003) that skills related to emotion and motivation were extremely important for individual success in the workplace. The affective domain skills have been requested by modern industry (TVE Directory, 2010) so the engineering courses from the TVE system should contain appropriate courses and learning activities which enable the development of affective skills of the TVE students during the teaching and learning processes.

Bloom's Psychomotor Domain of Learning - included technical and physical skills related to movement, coordination and practices. Alternative versions have been developed by various educators. Figure 2.3 shows Simpson's; Harrow's and Dave's versions (Anderson and Krathwhol, 2001), which all occupy single dimensions.

Simpson's psychomotor domain taxonomy		
Learning Level	***Category***	***Description***
1	Perception	Awareness
2	Set	Readiness
3	Guided response	Attempt
4	Mechanism	Basic proficiency
5	Complex response	Expert proficiency
6	Adaptation	Adaptable proficiency
7	Organisation	Creative proficiency

Harrow's psychomotor domain taxonomy		
Learning Level	***Category***	***Description***
1	Reflex movement	Involuntary reaction
2	Basic fundamental movements	Basic simple movement
3	Perceptual abilities	Basic response
4	Physical abilities	Fitness
5	Skilled movements	Complex operations
6	Non-discursive communication	Meaningfully expressive activity

Dave's psychomotor domain taxonomy		
Learning Level	***Category***	***Description***
1	Imitation	Copy action
2	Manipulation	Reproduce activity
3	Precision	Execute skill reliability
4	Articulation	Adapt and integrate expertise
5	Naturalization	Unconscious mastery of activity

Figure 2.3: Psychomotor learning taxonomy

Simpson's psychomotor domain taxonomy contained seven learning categories from the simplest level (perception) to more specialised and advanced proficiencies.

Harrow's psychomotor domain taxonomy included six categories, started from the category of reflex movement towards the category of non-discursive communication.

Dave's psychomotor domain taxonomy was the latest version which addressed the skills development related to practical applications. It contained five categories of the learning levels from imitation for basic skills to naturalisation for related skills at strategic level.

It was obvious that the three versions re-named and added some categories to the original Bloom's taxonomy. The learning levels were renamed and physical movement skills were expressed by action verbs. The learning levels were listed according to the skills required, from simple ones to the most complex ones. This taxonomy could be applied to design practical learning activities for students in the workplace environment.

The three domains (cognitive, affective, and psychomotor) emphasised the importance of including learning activities which enable the development of employability skills for TVE students. So the SBL and WBL modules should enable the development of employability skills related modern industrial requirements.

2.2.3 Experiential Learning Theory

Kolb (1984) formulated an experiential learning theory and model based on Dewey's philosophical expediency, Lewin's social psychology and Piaget's cognitive model. Kolb's theory explained in a structured manner the exchange of knowledge between students and teachers. Baker et al. (2002) confirmed that students' experiential learning uses conversation as a means of transforming knowledge into experience. The experiential learning theory included both academic and practical activities.

Figure 2.4 shows that the model is based on the idea that the students' learning preferences can be represented in two dimensions:

- Dimension one represents the transformation from (concrete experience) to (abstract conceptualisation) along the vertical axis, as the approach to acquiring knowledge;
- Dimension two represents the transformation from (reflective observation) to (active experimentation) along the horizontal axis as the process of acquiring knowledge.

Kolb's model contained four learning styles inventory (LSI):

Divergers learn from the concentrated experience, and process those experiences through reflective observation; they perform better in reviewing existing circumstances, listening to others' opinions, generating new ideas, conducting brainstorming sessions, and gathering information.

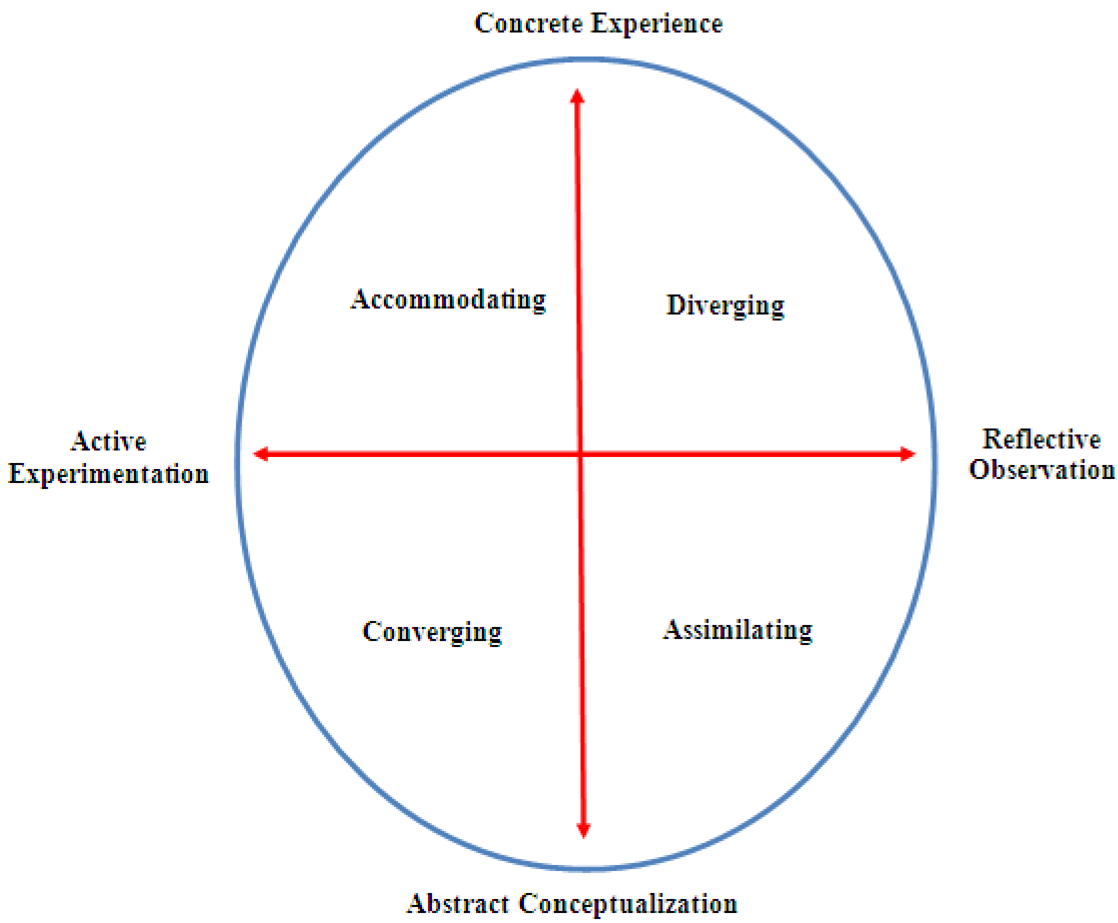

Figure 2.4: The experiential learning model and learning styles (From Kolb, 1984)

Assimilators themselves are theorists who have a preference for approaching knowledge acquisition through abstract conceptualisation, and complete learning activities through reflective observation. Assimilators prefer the theoretical learning approach as they are best at reading, thinking, analysing situations, and putting information into a logical sequence.

Convergers are the pragmatist learners who approach understanding through abstract conceptualisation and process things through active experimentation. They are the hands on learners who prefer practical applications, simulations, laboratories work, and new experiments with innovative ideas.

Accommodators are the activist learners who have a preference to approach knowledge through concrete experience and perform things through active experimentation. Students may gain new knowledge by working in groups, solving problems relying on others' information, and learning from other peoples' technical work; they prefer to watch and gather information rather than experiment with the practical applications.

McGill and Beaty (1995) indicated that the learning activities should contain various modes of delivery to meet students' learning preferences. Hillier (2009) added that the teaching and learning processes should be designed to accommodate students' preferred learning styles.

It was obvious that the LSI incorporated the four learning styles discussed above which represent the various needs of individual learners: diverging; assimilating; converging; and accommodating. These learning styles should be considered when designing the questions to analyse the teaching and learning processes in the TVE system in Bahrain. It also should examine the correlation between existing teaching and learning approaches with the preferred learning styles by the TVE students.

Chen and Macredie (2002) and Evans et al. (2002) explained that information technology gives students an opportunity to become more flexible in their teaching and learning processes, expand their interaction beyond traditional teaching and learning, access learning materials online and spend more time interacting with other students in online discussions. So, using information technology in the delivery of learning should suit individuals' behaviour, understand the learning activities in their preferred way of delivery, and provide a better learning environment to satisfy the students' various learning needs.

The next section discusses the impact of using innovative technology in teaching and learning processes. The emphasis of using technology is to provide various modes in the delivery of learning activities.

2.3 Impact of Using Technology in Teaching and Learning Processes

In the 1990s, electronic technology was used in the learning process, and e-learning has become an important phenomenon in improving that process. Yen et al. (2003) conducted a study on using e-learning in education system. They found that the e-learning system was not only a psychological phenomenon; they indicated that it can be beneficial for the educational system and industry, improving students' skills in the cognitive and affective domains.

Koc (2005) and Mumcu and Usluel (2010) explained that using technology in the TVE system is dependent on educational institutions' infrastructure and teachers' experience in using e-learning. Therefore, an appropriate budget for equipping schools with the technology and for training teachers in its use are vital elements for its successful implementation in the learning process. The rationale behind using technology in pedagogical practices in TVE was that it could be a practicable solution to meet the skills needs of industry as well as improving TVE outcomes.

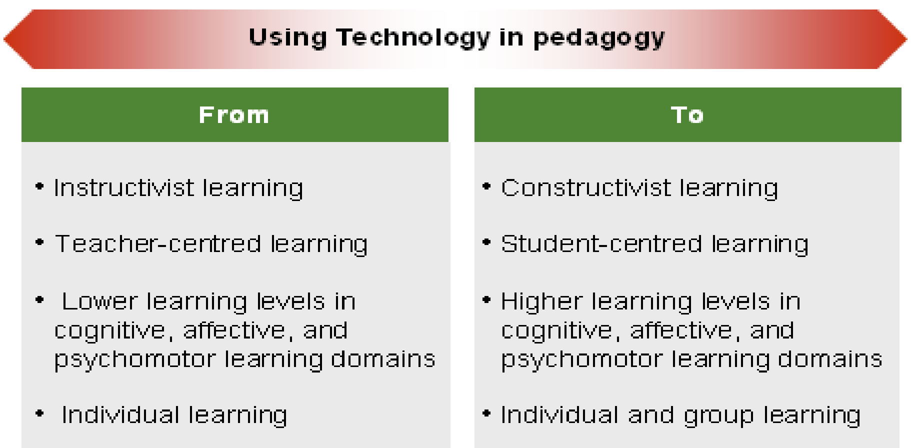

Figure 2.5: Advantages of using technology in teaching and learning processes

Figure 2.5 shows some advantages of using technology in the teaching and learning processes. It was obvious that integrating technology in the process of teaching and learning engineering courses would be useful to improve the effectiveness of TVE system. Also, using technology would enable the development of the relevant employability skills needed by the modern industry.

Flecknoe (2000) underlined that using technology in the teaching and learning processes improved the students' efficiency and reached different learning styles. The teachers could act as facilitators and observe students' interaction with technology.

Johnston and Barker (2002) added that technology could be used in educational reform (such as creating new engineering courses which would enhance and improve the learning process and develop students' cognitive and affective skills).

Using technology would introduce a new approach to learning in TVE. The engineering courses (practical modules) might be integrated and presented online which would motivate TVE students to learn and provide various modes of delivery for different learning styles. Therefore, the learning content for engineering courses should be presented online and contain videos, links, animations, graphs, and simulations.

The next section identifies the available literature in information quality frameworks which could be used to assess the effectiveness of a learning system using technology.

2.4 Information Quality Frameworks

Wang and Strong (1996) initiated the original work for setting standards for information quality frameworks. Their purpose was to critically evaluate users' viewpoints towards the content of a learning system and give priority to quality as an evaluation of excellence.

Figure 2.6 shows the information quality framework developed by Wang and Strong. There were 15 quality dimensions which were divided into four categories:

Intrinsic quality category measures the quality of the data which is independent from the users' point of view and consists of five dimensions:

- Believability: The e-learning system has updated and believable information.
- Accuracy: The e-learning system provides scientific and accurate information.
- Objectivity: The e-learning system has impartial learning information.
- Reputation: The e-learning system is effective and could be used in benchmarking.

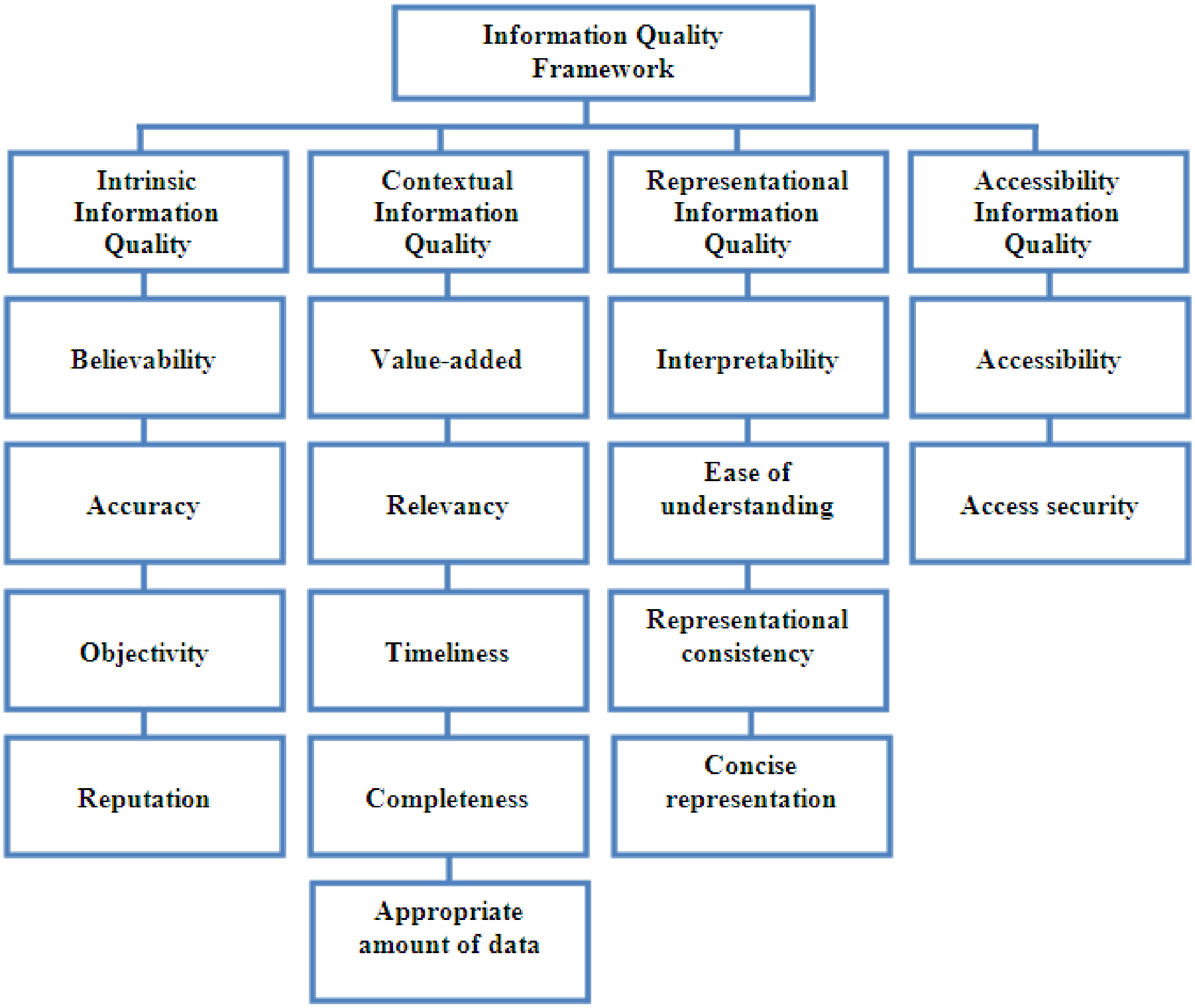

Figure 2.6: The original information quality framework (From Wang and Strong, 1996)

Contextual quality category is subjective to the users' preferences and measures the quality of the data with respect to the point of view. It consists of six dimensions:

- Value added: The e-learning system adds value to the learning content.
- Relevancy: The e-learning system contains relevant information.
- Timeliness: The e-learning system contains up-to-date information.
- Completeness: The e-learning system has information applicable to meeting the learning objectives and outcomes.
- Amount of information: The learning materials contain an appropriate amount of information in a structured manner.

Representational quality category measures the quality of how the data was represented in the e-learning system and consists of four dimensions:

- Interpretability: The learning content has clear and appropriate language, structure, and instructions.
- Ease of understanding: The e-learning system arranges the information in a way that can be easily understood.
- Representational consistency: The e-learning system is easy to use.
- Concise representation: The available information in the learning content is concise.

Accessibility quality category measures the quality of accessing the information in the e-learning system and two quality dimensions:

- Accessibility: The e-learning system can be easily accessed online.
- Access security: The access security features are enabled to protect the content of the e-learning system.

Table 2.7 presents an overview of the existing information quality frameworks. It was noticed that each framework was formulated to meet specific requirements. Overall, there were 19 quality dimensions represented in various frameworks and were flexible enabling their use for various e-learning systems.

The researcher has developed an extended information quality framework (see Chapter 7) which contains supplementary specific quality dimensions used to measure pedagogical issues related to industrial skills needs. The new quality dimensions represent cognitive skills, psychomotor skills, and affective skills that are required to be included in engineering courses in TVE system and needed by the industry. Therefore, the existing information quality frameworks were extended to a new version which incorporated specific quality dimensions for the TVE system in Bahrain.

From the literature review it was obvious that the teaching and learning processes could be improved by using technology. The pedagogical and technological aspects could be assessed through information quality frameworks. Also, they would assist TVE people to measure the effectiveness of the learning content in engineering courses, and motivate them to create innovative content that meets modern industrial skills needs (Alseddiqi and Mishra, 2011b).

Table 2.7: Information Quality Frameworks (Adopted from Knight and Burn, 2005 and Alkhattabi et al., 2010)

Data/Information Quality Framework	Quality Factors																		
	Intrinsic Quality Dimensions					**Contextual Quality Dimensions**						**Representational Quality Dimensions**				**Accessibility Quality Dimensions**			
	Believability	Accuracy	Objectivity	Reputation	Consistency	Value-added	Relevancy	Timeliness	Completeness	Amount of Information	Verifiability	Interpretability	Ease of Understanding	Representational Consistency	Concise Representation	Accessibility	Access Security	Response Time	Availability
Wang & Strong (1996)	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X		
Gertz (1996)		X					X		X	X									X
Redman (1996)		X	X				X		X	X	X	X		X	X				X
Zeist & Hendriks (1996)		X					X	X		X			X			X	X		
Jarke & Vassiliou (1997)	X	X			X		X	X	X			X		X			X	X	X
Chen et al (1998)		X					X	X	X	X								X	
Alexander & Tate (1999)	X	X	X	X				X	X	X				X		X			
Dedeke (2000)		X			X		X	X	X	X			X			X		X	
Zhu & Gauch (2000)	X		X				X	X								X		X	
Leung (2001)		X					X	X	X	X						X	X	X	
Khahn et al (2002)	X		X		X			X	X	X			X	X		X		X	
Klein (2002)	X		X				X	X	X	X									
Mecell et al (2002)		X			X			X	X										
Liu & Han (2005)		X		X	X		X	X	X					X		X		X	
Besiki et al (2007)		X		X			X		X		X					X	X		
Alkhattabi et al (2010)	X	X	X	X	X	X	X		X	X	X		X	X		X		X	X
Frequency	**7**	**13**	**7**	**5**	**6**	**2**	**13**	**11**	**14**	**11**	**3**	**3**	**5**	**7**	**2**	**10**	**5**	**8**	**4**

2.5 Development of Questionnaires and Data Analysis to Responses

A questionnaire is a set of questions/statements to obtain answers related to various topics (Oppenheim, 2001). The questionnaire should be designed in such a way as to engage the respondents' interest, encourage co-operation and extract reliable and accurate data.

Following drafting and construction, the clarity of the questionnaires should be examined to eliminate overlapping ideas, evaluate the validity of the questions, and ensure that they reflect important elements (Cooper and Schindler, 2006). This could be done by informal testing the draft questionnaire, revising and re-testing it, and finalising its parts and contents.

Questionnaire design- is essential to put relevant questions which should give the information required from the questionnaire. Saunders el al. (2009) added that reviewing relevant literature is required to have an idea for designing the questionnaire. So, the questions could be adopted or adapted from other questionnaires or the researcher could develop their own questions based on the reviewed information in literature. Oppenheim (1992) classified the questions as being closed (aimed to receive quick and specific answers which are easy to be analysed) or open (requiring the respondents to make comments and address any issues that might not be covered in closed questions). The design of closed questions should offer sufficient options for answers in order to avoid the bias of answers. It could use Ranking Likert Scale, Semantic Differential Scale, Checklists, and Two-way Questions. Generally it could be difficult to summarise and analyse the answers for open questions which might require more time for analysis than the closed questions.

Piloting the Questionnaire - should be carried out by experts who should indicate how long would it take to complete the questionnaire and assist to avoid ambiguity in the questions.

Reliability, validity and bias - Cooper and Schindler (2006) defined reliability as the measurement of the consistency of questions. So, the questions should have dependable information which means similar results could be obtained when using the questionnaire again. The questions included in the questionnaire should be designed with simple words to avoid ambiguity and to be easily understood and followed (Oppenheim, 1992; Kumar, 1996). A clear sequence should be followed to structure the questions with an accurate plan to avoid confusion (Saunders et al., 2003). Ambiguous questions could be considered as threats to the reliability of the questionnaire. Validity could be defined as accurate and clear questions statements included in the questionnaire. So, the questionnaire validity could be expressed by examining the content of the questions to ensure that the questions would be formulated to measure various variables to obtain the questionnaire objectives. Also the questions should be un-biased (i.e. avoid leading questions) in order to achieve the purpose of the questionnaire.

Table 2.8: Qualitative and quantitative aspects related to the questionnaire design (Adopted from Dey, 1993)

Qualitative aspects	**Quantitative aspects**
The questions are open ended and the answers represent people's opinions	The questions are closed with definite answers
Data collection consists in classifying non standardised data into categories	Data collection is based on numerical and standardised data
Data analysis is conducted through the use of conceptualisation	Data analysis is conducted through statistics and charts

Table 2.8 shows the qualitative and quantitative aspects related to the questionnaire design. The quantitative and qualitative methods were used for data analysis from questionnaires. These methods complement each other in terms of answering the research questions and increase the research validity. Eden and Huxham (1996) confirmed that triangulation was necessary to gather information qualitatively as well as quantitatively.

2.6 Conclusions

The literature review brings out the strong links between employability skills models, theories and models of learning, technology for teaching and learning processes, and information quality frameworks.

Kearns (2001) proposed an improved version of Mayer's model which divided the employers' skills requirements to work readiness and work habits, interpersonal skills and enterprise, innovation and creativity skills, and learning, thinking and adaptability. Gibb (2004) added new sets of skills recommended by the industry as for future needs, including involvement in community services, citizenship and knowledge and skills. Dacre and Sewel (2007) proposed an extended version of the NCVQ model which included generic skills, emotional intelligence, career development learning, experience from work and life, reflection and evaluation, and self-esteem and self-confidence.

The employability skills included in the reviewed models could be categorised into three main criteria, cognitive skills, affective skills, and psychomotor skills. They were discussed and were related to various vocational systems that the TVE system in Bahrain was benchmarked against their educational systems.

The three domains of skills (cognitive, affective, and psychomotor) emphasised the importance of including learning activities which enable the development of employability skills for TVE students. After that Kolb's model which as formulated an experiential learning theory was reviewed for proposing effective teaching and learning provisions for the TVE system.

After that technology was incorporated in the teaching and learning processes to meet the obvious individual learners' needs. The rationale behind using technology in pedagogical practices in TVE was that it could be a practicable solution to meet the skills needs of industry and improving TVE system.

The information quality frameworks were reviewed and suggested that it could be used to assess the effectiveness of a learning system using technology. The frameworks are flexible and could be extended to meet various needs of the TVE system (i.e. assessing the employability skills incorporated in the learning content of engineering courses).

2.7 Scope and Objectives of the Study

After reviewing the literature, the researcher identified a number of issues that should be pursued in this research.

The scope of this research is to minimise the skills gap between Technical and Vocational Education System (TVE) and modern industrial requirements in the Kingdom of Bahrain. More specifically, the factors responsible for this gap have been identified as: lack in the improvement of the content of engineering courses, continued use of traditional teaching and learning processes, and limited use of technology in these processes.

The main objectives of this research are to:

- Determine how the TVE system can continually improve the effectiveness of engineering courses.
- Develop an employability skills training model considering the skills gap between TVE system and industrial requirements.

- Elaborate and analyse two-dimensional (2D) models including cognitive, affective and psychomotor skills based on the employability skills training model and literature review.
- Design and develop a new module for SBL-to-WBL transition (SWT) based on 2D models and user centred design approach. The module incorporates new teaching and learning processes using technology and the developed online learning package.
- Develop an evaluation quality framework for measuring the effectiveness of the pedagogical and technological aspects of TVE engineering courses.
- Propose improvements of the new SWT module based on user evaluation, perspectives of TVE policy and industrial needs and expectations.

2.8 Research Plan

From this review a plan was formulated and the following investigation stages were outlined:

a) Evaluate the existing TVE system in Bahrain and identify its strengths and areas for improvement from official reports prepared by the Ministry of Education.

b) Design Questionnaire 1 which should identify the employability skills gap between TVE system and industrial skills requirements. The responses given by TVE teachers, industrial supervisors, and HR specialists from industry are analysed with Statistical Package for the Social Sciences (SPSS).

c) Propose an employability skills training model based on employability skills gap between TVE system and industrial skills requirements.

d) Elaborate and analyse 2D models including cognitive, affective and psychomotor skills based on the employability skills model and literature review.

e) Design, develop and implement a new SWT module aiming to ensure that TVE students receive the necessary training required by industry before they go to work placement.

- Analyse institutional, pedagogical and technological contexts for the SWT module.
- Perform the user analysis by Questionnaire 2 which is based on Kolb's learning styles inventory. The TVE teachers and students' responses are analysed with Excel package.
- Use the 2D models for the design of learning activities which are included in the proposed SWT module.

- Design the e-learning package included in the proposed SWT module based on user centred design. The five case studies are related to real work environment and the learning activities enable the development of cognitive, affective and psychomotor skills for students.
- Perform the user evaluation by Questionnaire 3 which is based on an extended quality framework. The responses from teachers and students are analysed with SPSS package.

f) Use the results from Questionnaire 3 to develop an evaluation quality framework for future improvements of the effectiveness of TVE engineering courses.

g) Formulate suggestions for the improvement of TVE policy in Bahrain.

Figure 2.7 contains the research plan including the research activities carried out over three academic years.

The next chapter presents the proposed employability skills training model based on the results of quantitative and qualitative analysis of the answers given to Questionnaire 1.

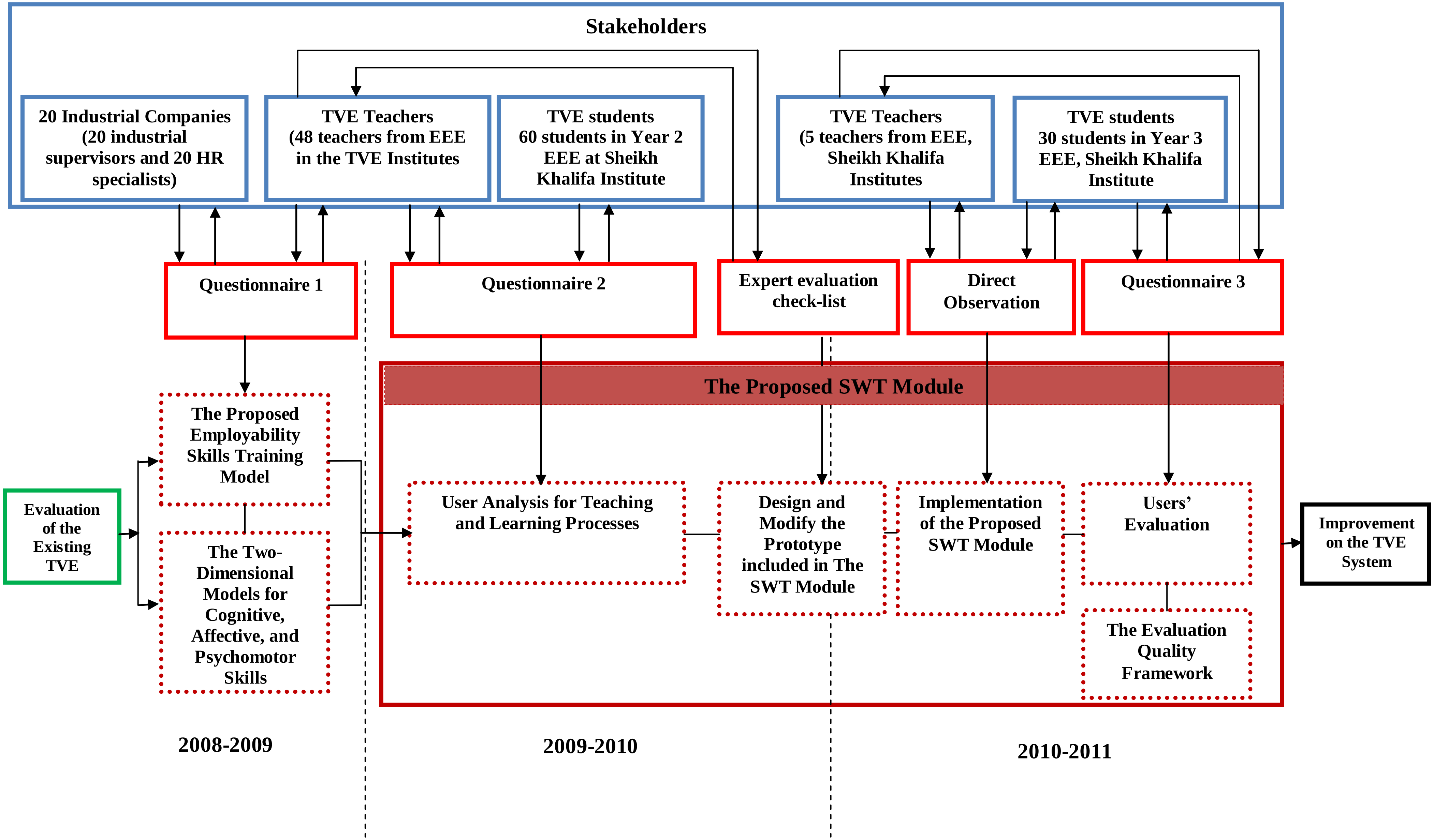

Figure 2.7: The research plan

CHAPTER 3 - The Proposed Employability Skills Training Model

This chapter presents the development of a novel employability skills training model based on the results of quantitative and qualitative analysis of the responses to Questionnaire 1 by the teachers from four TVE institutions (Sheikh Khalifa, Aljabria, Sheikh Abdulla, and Jidhafs), industrial supervisors and specialists from Human Resources departments from industry.

Questionnaire 1 aimed to identify the gap between the students' skills developed by studying the modules included in SBL and WBL programmes and the skills required by industrial companies in Bahrain. A new model for employability skills is specifically proposed, to satisfy both the TVE (internal) objectives and industrial (external) requirements. The new model could be used for structuring the content of engineering courses in the TVE system with respect to cognitive, affective, and psychomotor skills.

3.1 The Design for Questionnaire 1 (Employability Skills Questionnaire)

Three groups of stakeholders in the TVE system were asked to complete the questions as mentioned in Questionnaire 1:

- **Teachers** – who are leading Electrical and Electronics Engineering (EEE) modules included in Years 1, 2, and 3. They indicate the employability skills acquired by students from SBL.
- **Specialists from Human Resources (HR) departments from industrial companies** – accept students in the WBL programme in Year 3. They identify the modern industrial skills requirements from various engineering sections in the industries.
- **Industrial supervisors** – who manage the TVE students in WBL programmes in Year 3. They indicate the employability skills acquired by TVE students after completion of the WBL.

Figure 3.1 shows that Questionnaire 1 (*see Appendix A1*) contains 49 questions which are divided into three parts:

Part 1 - respondents' details: gender, age, experience, department, and job title.

Part 2 - questions based on Bloom's taxonomy – refer to cognitive, affective and psychomotor skills and had a random distribution in order to avoid the focus on respondents to one specific category (domain).

Part 3 – Additional information.

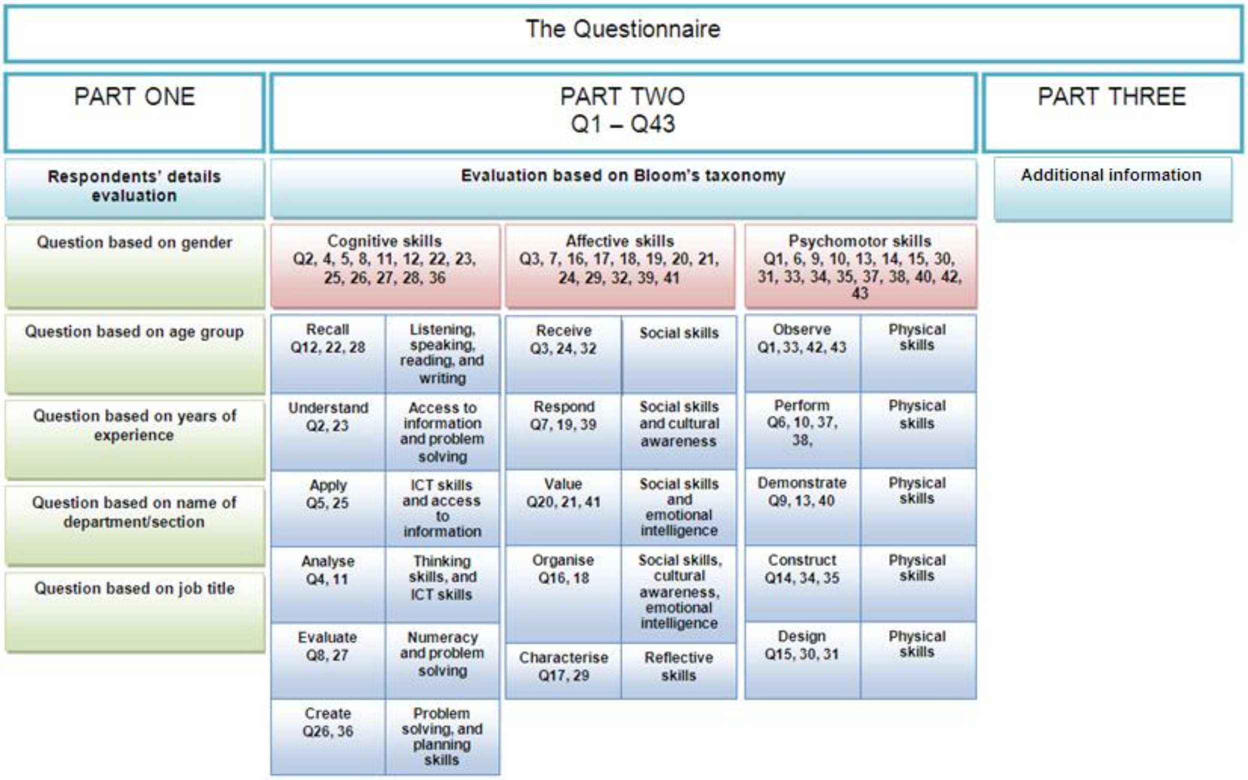

Figure 3.1: The structure of Questionnaire 1

The responses to the 43 questions from Part 2 were designed with a 5-point Likert Response Scale (Cooper and Schindler, 2006). The questions related to Bloom's taxonomy refer to:

a- *The cognitive domain* – the 13 questions refer to the lower learning levels (recall data, understand, and apply) and the higher ones (analyse, evaluate, and create). The questions were ranked and divided according to the importance of the cognitive domain learning levels in the existing TVE system.

b- *The affective domain* – the 13 questions refer to the five levels of learning (lower levels - receive, respond, and value and higher levels - organise and characterise).

c- *The psychomotor domain* – the 17 questions refer to physical, coordination and interpersonal skills: observe, perform (lower learning levels) and demonstrate, construct and design (higher learning levels). As the existing TVE system is more oriented to practical learning applications, it was noticed that more questions were allocated to this category compared to the previous ones.

Part 3 contained an open-ended question, intended for respondents to make comments and address any issues omitted from the earlier sections.

3.2 Categories of Respondents to the Questionnaire

Saunders et al. (2003) stressed that purposive sampling should allow for selecting cases that best enabled answering the research questions and meeting the research objectives. They added that purposive sampling was the most appropriate technique for a given sample size and available resources.

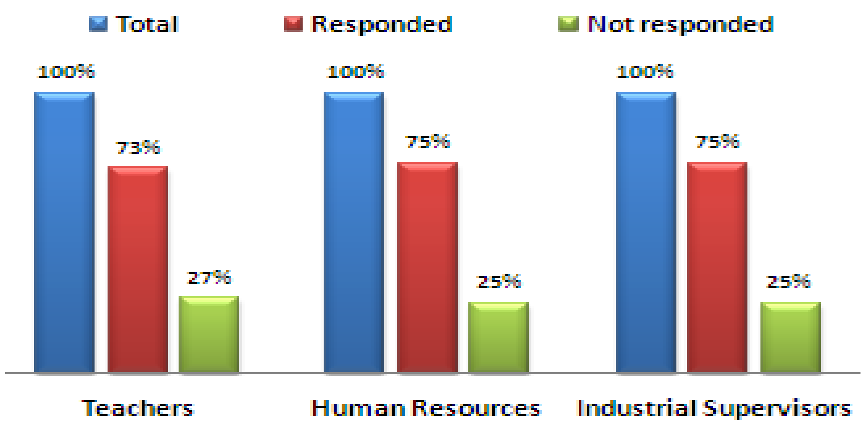

Figure 3.2: The response rate for questions

Figure 3.2 shows the proportion of questionnaires that were completed:

Teachers – a number of 48 teachers from four TVE institutions (Sheikh Khalifa, Aljabria, Sheikh Abdulla, and Jidhafs) were asked to complete Questionnaire 1. Only 35 people (representing 73%) who deliver both theoretical and practical modules during SBL programmes in Year 1, Year 2 and Year 3 have answered the questions. The main expected outcome was the teachers' opinions regarding the students' skills acquired during SBL programmes.

Specialists from Human Resources (HR) departments from industrial companies – a number of 20 individuals from various companies which usually received TVE students for the WBL programmes were asked to complete Questionnaire 1. There were 15 HR specialists who responded to the questionnaire. Their answers should give a better idea about the industry expectations because the HR specialists collect the skills and qualifications required by various departments within the company.

Industrial supervisors – a number of 15 supervisors responded to Questionnaire 1 in order to evaluate the skills acquired by the students during WBL programme.

There are 20 different industrial companies that accept TVE students for the WBL, such as electrical, electronic, telecommunications, building services, mechanical engineering and computer technology (TVE Directory, 2010). The students are distributed to various engineering sections in the industry based on their specific engineering specialisations in Year 3 of study. The selected industrial companies contained training centres, experienced supervisors, and different engineering disciplines.

In total there were 65 respondents, with a variety of demographics. This allowed for an unbiased sample population whose data could be collected and analysed with minimised chance of error within the overall results (Saunders et al., 2003).

3.3 Data Analysis

Statistical Package for the Social Sciences (SPSS) version 18 was used to analyse the data for Questionnaire 1. The respondents' details (Part 1) were analysed by using frequency, percent, and cumulative percent variables. The evaluation questions based on Bloom's domains (Part 2) were analysed by using the descriptive statistics (including frequency distributions, and average responses). The responses to the open ended question included in Part 3 were analysed qualitatively.

3.3.1 Data Analysis for Part 1(Evaluation of Respondents Details)

Table 3.1 shows the gender category for the respondents of 65. The total teachers' respondents (T) were 35, where 19 were males and 16 were females. The majority industrial supervisors (IS) were males because the industrial companies in Bahrain concentrate mostly on males. The table also indicates that the total number of human resources (HR) respondents was 15 and about two-thirds of human resource respondents were females.

Table 3.1: Respondents by gender

Gender	Total number of respondents			Percent		
	T	IS	HR	T	IS	HR
Male	19	11	5	54.3	73.3	33.3
Female	16	4	10	45.7	26.7	66.7
Total	**35**	**15**	**15**	**100**	**100**	**100**

Table 3.2 shows the respondents by age group. It was obvious that the TVE system in Bahrain had a mixed of young and old teachers. In addition the teachers' respondents had different knowledge of modern technology and modern industrial requirements are more up to date. The table indicates that 53 % of industrial supervisors' respondents were 21-29 years of age so their knowledge of modern technology and modern industrial requirements is more up to date. In addition, the table indicates that the HR specialists' respondents belong to the age groups 21 – 39 years.

Table 3.2: Respondents by age group

Age Group	Total number of respondents			Percent		
	T	IS	HR	T	IS	HR
21-29	5	8	7	14.3	53.3	46.7
30-39	11	6	8	31.4	40.0	53.3
40-49	16	1	-	45.7	6.7	-
50-59	3	-	-	8.6	-	-
Total	**35**	**15**	**15**	**100**	**100**	**100**

Table 3.3 indicates the distribution of the respondents by years of experience in TVE. The majority of teachers had worked for 5 to 20 years (77%) so the provided answers represent the opinions of people who have a reasonable amount of experience in teaching. The majority of industrial supervisors (80 %) had between 1-10 years of experience. Their responses gave a good overview of the industrial requirements from people with various qualifications and experiences. The table also shows the HR responses. The majority (60%) had 5-10 years experience and only one respondent had more than 20 years experience. It was encouraging the HR specialists who responded to Questionnaire 1 could provide a valuable description of the industry requirements regarding employability skills.

Table 3.3: Respondents by years of experience

Years of experience	Total number of respondents			Percent		
	T	IS	HR	T	IS	HR
1-4	6	6	3	17.1	40.0	20.0
5-10	11	6	9	31.4	40.0	60.0
11-20	16	3	2	45.7	20.0	13.3
More than 20	2	-	1	5.7	-	6.7
Total	**35**	**15**	**15**	**100**	**100**	**100**

A number of 65 people have completed Questionnaire 1 which covered a wide range of age groups and job titles. This allowed for an unbiased sample to be collected and analysed with nominal chance for error among the overall results. It is worth mentioning that the engineering sector is still male-dominated in Bahrain and most of the female respondents were from HR departments.

3.3.2 Data Analysis for Part 2 (Evaluation Based on Bloom's Taxonomy)

The output from the analysis of Part 2 is the descriptive statistics for all variables under investigation by showing the mean, standard deviation and number of respondents who answered Questionnaire 1. As shown in table 3.4, the questions included in the Part 2 of the questionnaire were categorised into three dimensions corresponding to Bloom's taxonomy:

- Dimension one (cognitive domain skills)
- Dimension two (affective domain skills)
- Dimension three (psychomotor domain skills).

Appendix A2 (Tables A2.1-A2.3) contains the descriptive statistics from SPSS package for all questions included in Part 2. Table 3.13 shows a summary for the means and standard deviations for the responses related this part.

Mean – commonly called the average, is the arithmetic mean across the observations showing the measure of a central value. The mean value is determined by adding all data values and then divides the sum by the total number (n) of data values.

Variance – is a measure of variability and the sum of squared distances of data value from the mean divided by the variance divisor.

Standard deviation – is the square root of the variance and measures the spread of a set of observations. The larger the standard deviation is, the more spread out the observations are.

Table 3.4: Descriptive statistics from SPSS package for Part 2

Respondents	Mean	Standard Deviation	Total Number of Respondents
Teachers			**35**
Cognitive Domain	2.8	0.85	
Affective Domain	2.8	0.98	
Psychomotor Domain	3.2	0.7	
Average	**2.9**		
Human Recourses Specialists			**15**
Cognitive Domain	3.5	0.72	
Affective Domain	4.3	0.38	
Psychomotor Domain	3.6	0.68	
Average	**3.8**		
Industrial Supervisors			**15**
Cognitive Domain	2.7	0.7	
Affective Domain	3.1	0.89	
Psychomotor Domain	2.8	1.1	
Average	**2.9**		

- Teachers

Table 3.4 shows that psychomotor domain has the highest average value of 3.2 while the cognitive and affective domains have the average value of 2.8 equally. The average value of 3.2 indicated that the TVE teaching and learning processes concentrated on developing physical and technical skills rather than attitude and knowledge. As teachers in TVE institutions usually followed compulsory curricula to be completed within a restricted timescale, they would not have the opportunity to involve students in other activities (such as industrial visits) to develop other skills related to knowledge and attitude. To conclude, the teachers have considered the skills acquired by TVE students in SBL based on the existing curriculum and learning outcomes in SBL modules.

The standard deviation could be calculated by using the formula below:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}} \qquad (1)$$

Where σ is the standard deviation, N is the total number of the samples (i.e. total number of respondents to Questionnaire1), i is the iteration number, x_i is the respondent and $\bar{x}$ is the mean value.

Figure 3.3 shows the distribution of teachers' responses for the cognitive, affective, and psychomotor domains questions where the limits ±1 for standard deviations (SD) are considered.
For example, the average (mean) value for the cognitive domain is 2.8 and the standard deviation is 0.85 (so the majority of answers are clustered around the mean value). The SD upper limit is 3.65 and SD lower limit is 1.95. Hence, the upper limit is closer to point 4-Agree (from 5-point Likert Response Scale) whereas the lower limit is closer to point 2-Disagree (from 5-point Likert Response Scale). It can be seen that most of the data found within the ±1 standard deviations, however, three values are beyond the higher limit and one value is beyond the lower limit (see Figure 3.3).

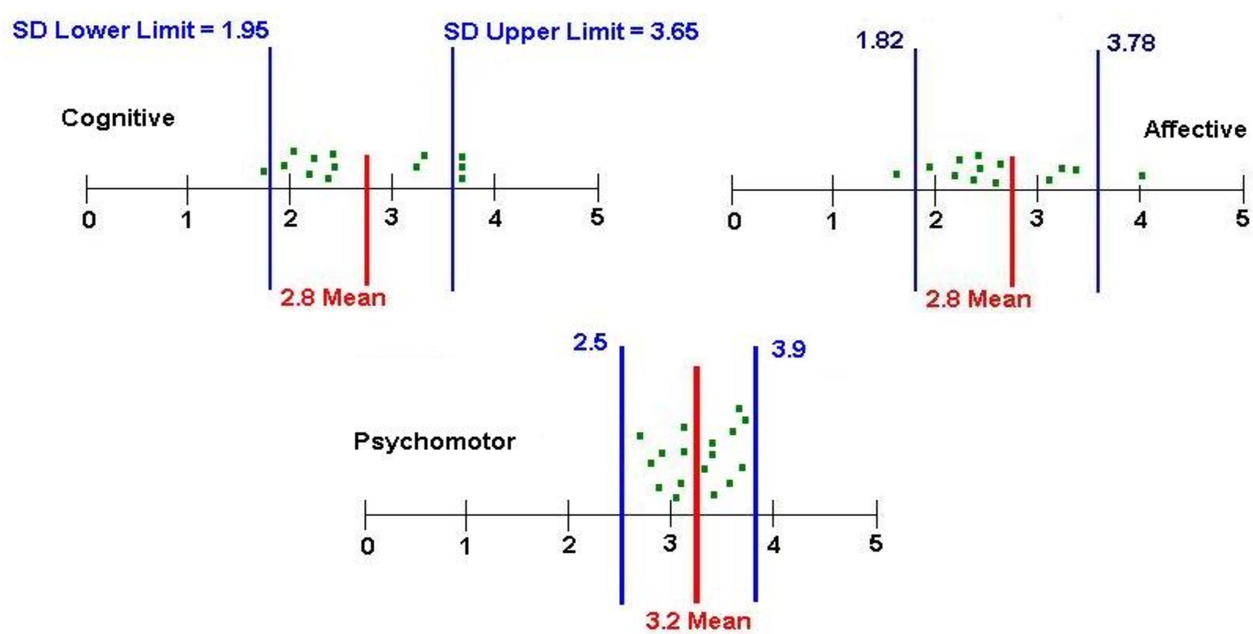

Figure 3.3: Distribution of teachers' responses for the cognitive, affective and psychomotor domains questions

It was indicated from the teachers' responses to cognitive, affective, and psychomotor domains questions that most of the data could be found within the ±1 standard deviations. It was decided that all the responses for the 43 questions (part 2 of Questionnaire 1) were considered in the descriptive statistical analysis because the teachers were experts who had a reasonable amount of experience in teaching and had provided answers which represented their opinions with regard to the employability skills acquired by TVE students in SBL.

- Specialists from Human Resources (HR) departments from industrial companies

Table 3.4 presents HR specialists' responses to the questionnaire. It can be seen that the grand mean is 3.8. On the basis of mean average scores, it can be seen that out of the three dimensions, in affective domain the overall score is maximum (4.3), followed by psychomotor domain (3.6) and cognitive domain (3.5). The specialists from HR indicated the requirements formulated by the managers and the employees of the engineering departments. They have shown that the affective domain skills (such as problem-solving skills, working in groups, cultural awareness, social competencies, emotional intelligence etc) are considered as being very important by the employers.

Figure 3.4 shows the distribution of HR specialists' responses for the cognitive, affective, and psychomotor domains questions when the limits ±1 for standard deviations (SD) are considered.

For example, the average (mean) value for the affective domain is 4.3 and the standard deviation is 0.38 The SD upper limit is 4.68 (closer to point 5 – Strongly Agree) and SD lower limit is 3.98 (closer to point 4 –Agree). It can be seen that the data found within the ±1 standard deviations, however, three values are beyond the higher limit and one value is beyond the lower limit.

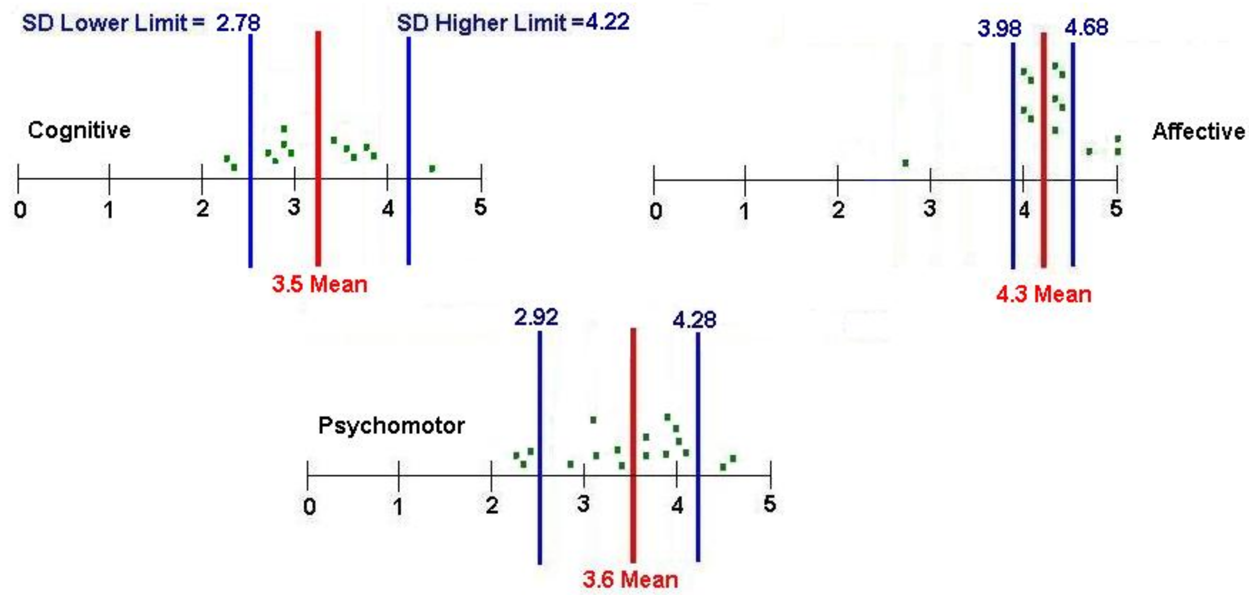

Figure 3.4: Distribution of HR specialists' responses for the cognitive, affective and psychomotor domains questions

It was noticed that increasing the limits to ± 2 standard deviations and ± 3 standard deviations could be chosen to contain all questions within the upper and lower limits but the larger the standard deviations limits are, the more spread out the data is. It was encouraging the HR specialists who responded to Questionnaire 1 could provide a valuable description of the industry requirements regarding employability skills, so their opinions were vital important, therefore all responses including the ones outside limits of ±1 standard deviations were considered in the descriptive statistical analysis.

- Industrial supervisors

Table 3.4 also presents the descriptive statistics of responses from industrial supervisors. The grand mean is 2.9. Analysing the industrial supervisors' responses, it can be seen that affective domain has the highest average value of 3.1, followed by psychomotor domain (2.8) and cognitive domain (2.7). The industrial supervisors indicated the skills acquired by TVE students in WBL programme.

Figure 3.5 shows the distribution of industrial supervisors' responses for the cognitive, affective, and psychomotor domains questions when the limits ±1 for standard deviations (SD) are considered. For example, the figure shows the distribution of industrial supervisors' answers for the psychomotor domain questions when the limits ±1 for standard deviations (SD) are considered. The average (mean) value for the psychomotor domain is 2.8 and the standard deviation is 1.1. The SD upper limit is 3.9 (closer to point 4 – Agree) and SD lower limit is 1.7 (closer to point 2 – Disagree). It can be seen that most of the data found within the ±1 standard deviations, however, one value is found beyond the upper limit and the same is also found beyond the lower limit.

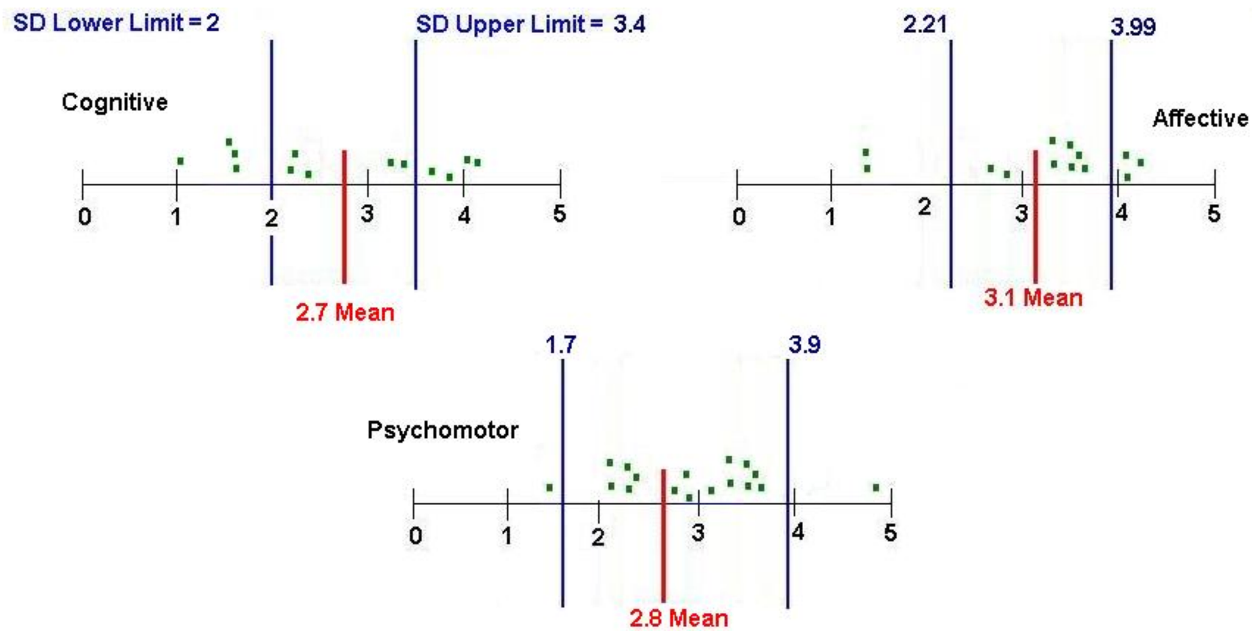

Figure 3.5: Distribution of industrial supervisors' responses for the cognitive, affective and psychomotor domains questions

It was noticed that increased the limits to ± 2 standard deviations and ± 3 standard deviations could be chosen to contain all questions within the upper and lower limits but the larger the standard deviations limits are, the more spread out the data is. The responses from the industrial supervisors gave a good overview of the industrial requirements from experts with various qualifications and experiences, so their opinions were vital important, therefore all answers including the ones outside limits of ±1 standard deviations were considered in the descriptive statistical analysis.

- **Conclusions for the data analysis related to Part 2**

Figure 3.6 shows the comparison of the average scores in all three domains:

Cognitive domain – the average score for HR specialists (green bar) is higher than the scores for teachers (blue bar) and industrial supervisors (red bar). It was obvious that the industrial requirements for cognitive domain skills exceeded the level of skills acquired by TVE students in SBL and WBL programmes.

Affective domain – the average score for HR specialists (green bar) shows that the industrial companies ranked the affective domain skills as the most important ones in comparison with the skills related to cognitive and psychomotor domains. It was obvious that the industrial skills requirements from affective domain skills exceeded what has been achieved by TVE students in SBL (teachers' responses) and what has been achieved in WBL (industrial supervisors' responses).

Psychomotor domain – the average score for HR specialists (green bar) is higher than the scores for teachers (blue bar) and industrial supervisors (red bar). It was obvious that the industrial requirements from psychomotor domain skills exceeded the level of skills acquired by TVE students in SBL and WBL programmes as shown by teachers' and industrial supervisors' responses.

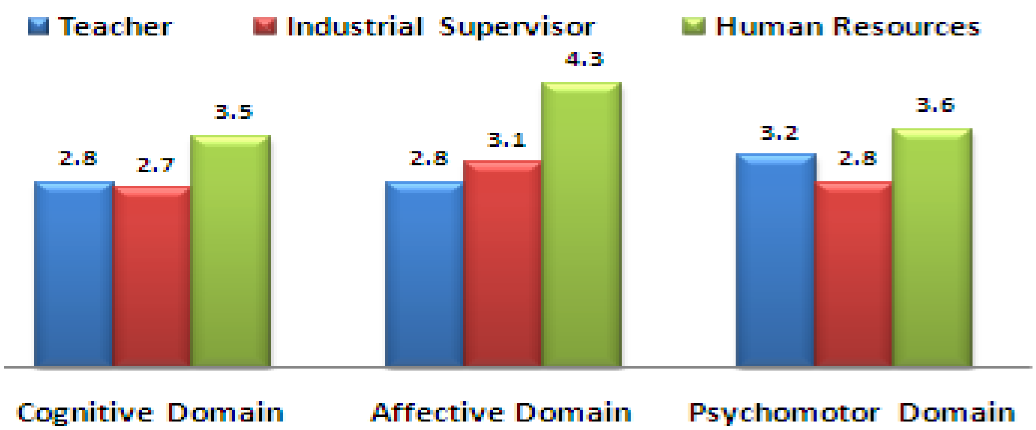

Figure 3.6: Comparison of the respondents' answers to Part 2

It was therefore shown that the affective domain skills (which are very important in the industrial setup) were not integrated effectively in SBL and WBL programmes. These findings confirmed the indications from other studies, which give importance to the presence of the affective domain effects within the educational curriculum (Shephard, 2008; Kara, 2009). Hewitt et al. (2011)

agreed with Lopez and Snyder (2003) that skills related to affective domain are extremely important for individual success in the workplace. In conclusion the SBL and WBL curriculum should be improved by including more teaching and learning activities which enable the development of students' affective domain skills.

The preferences of teachers, HR specialists and industrial supervisors for various skills included in the three domains related to Bloom's taxonomy are discussed in Figure 3.7, 3.8, and 3.9.

Figure 3.7 shows the responses to the cognitive domain questions where the *x* axis represents the cognitive domain questions and the *y* axis shows the mean value for each question with respect to the identified groups of respondents.

- Teachers' responses (blue bars) indicated the level of cognitive domain skills acquired by TVE students in SBL.
- Industrial supervisors' responses (red bars) indicated the level of cognitive domain skills acquired by TVE students in WBL.
- Human resources specialists' responses (green) indicated the level of cognitive domain skills required by the industry.

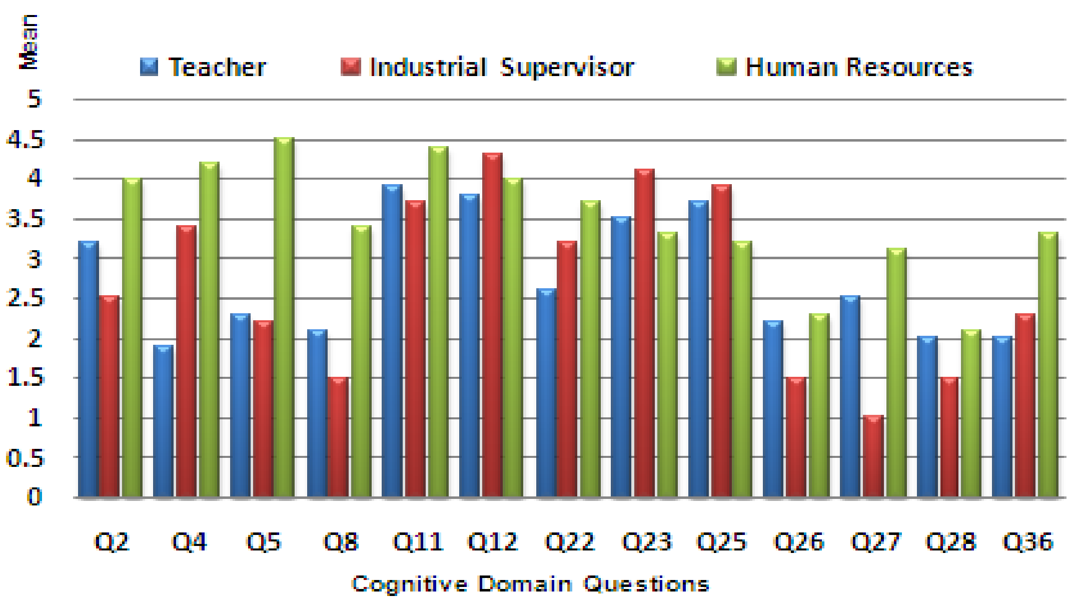

Figure 3.7: Comparison of respondents' evaluation for cognitive domain questions

The responses from teachers showed that the skills levels offered by TVE students in SBL were below the industrial expectations. Cognitive skills (including listening, reading, writing and ICT skills) were integrated well in the existing theoretical and practical modules from SBL. In addition, teachers had almost the same opinions as HR specialists for TVE students' understanding of company organisational structure (Q23), solving conflicts (Q26), and formulating effective decisions in certain tasks (Q28).

Industrial supervisors pointed out that TVE students performed better in WBL than in SBL in the following cognitive specific skills: understanding the work procedures, regulations and working days and hours (Q25), understanding health and safety standards (Q12), applying information technology skills (Q5 and Q11), and proposing innovative ideas for the work plan and procedures (Q36).

However, the HR specialists indicated that industry require that TVE graduates to have higher abilities in understanding problem-solving activities (Q2 and Q27), analysing information (Q4), using mathematical knowledge in practice (Q8), introducing innovative ideas in implementing practical tasks (Q36), and applying ICT skills effectively in the workplace (Q5 and Q11). In conclusion there was a significant cognitive skills gap between the skills developed during SBL and WBL programmes and the industry requirements.

Figure 3.8 shows the responses to the affective domain questions. The *x* axis represents the assigned questions for affective domain skills, and the *y* axis shows the mean value for each question.

- Teachers' responses (blue bars) indicated the level of affective domain skills developed by TVE students in SBL.
- Industrial supervisors' responses (red bars) indicated the level of affective domain skills developed by TVE students in WBL.
- Human resources specialists' responses (green) indicated the level of affective domain skills required by the industry.

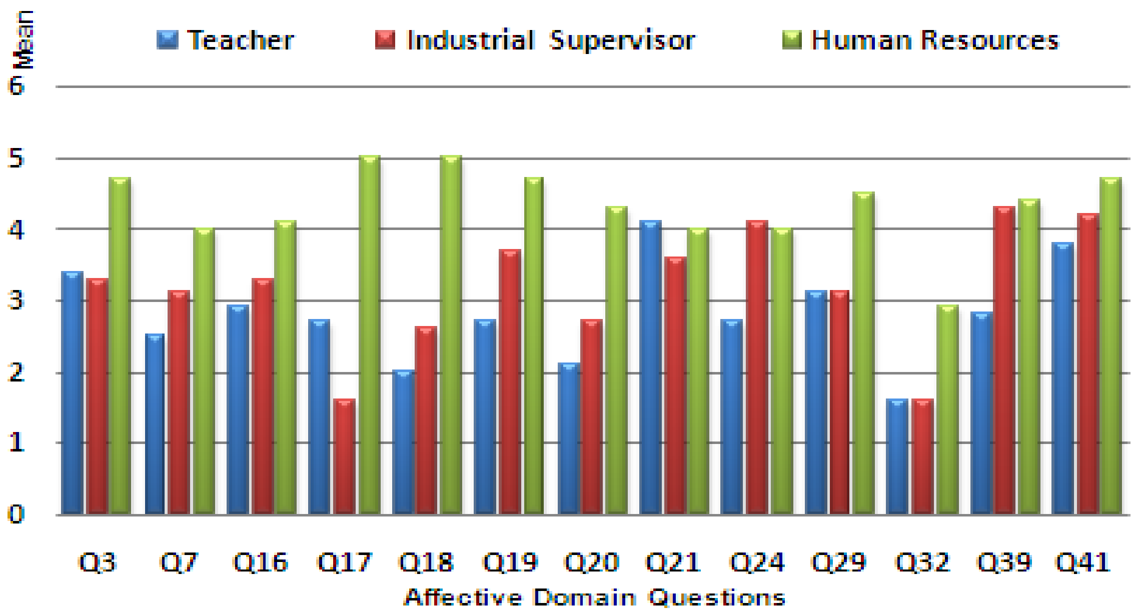

Figure 3.8: Comparison of respondents' evaluation for affective domain questions

The responses given by industrial supervisors showed that the affective skills of students attending the work placement included in WBL programme were improved in comparison with their performance and attitude during SBL. Also the industrial supervisors emphasised the need to include more teaching and learning processes in theoretical and practical modules in SBL and WBL programmes which enable the development of affective skills.

The responses from HR specialists confirmed that there is a gap in TVE students' affective domain skills in SBL and WBL compared to the standards and requirements of industry. They indicated the skills gap in the following specific affective domain skills: improving students' effectiveness in work participation (Q7), commitment to continuing improvement (Q18), having a positive attitude to change (Q29), improving self-confidence in a corporate workplace environment (Q17), encouraging students to listen to each other and share ideas (Q3), respecting others' ideas (Q21), and maintaining a good rapport with teachers and industrial supervisors (Q39). In addition, the specific affective domain skills also contain problem-solving skills, working in groups, cultural awareness, social competencies, emotional intelligence, and reflection skills.

Figure 3.9 shows the responses to the psychomotor domain questions. The *x* axis represents the assigned questions for psychomotor domain questions, and the *y* axis shows the mean value for each question.

- Teachers' responses (blue bars) indicated the level of psychomotor domain skills acquired by TVE students in SBL.
- Industrial supervisors' responses (red bars) indicated the level of psychomotor domain skills acquired by TVE students in WBL.
- Human resources specialists' responses (green) indicated the level of psychomotor domain skills required by the industry.

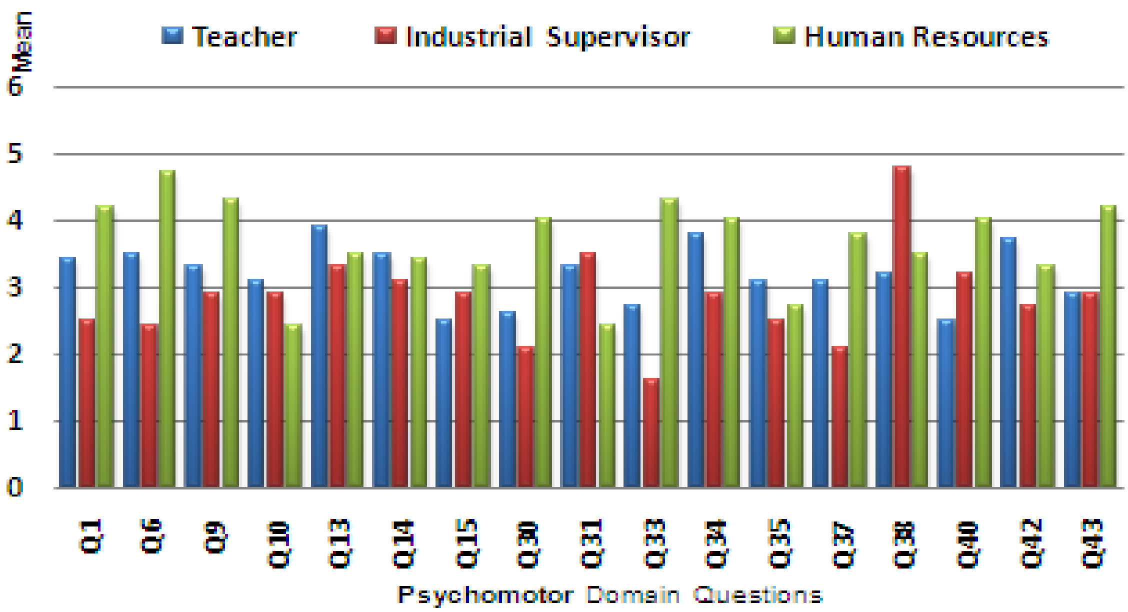

Figure 3.9: Comparison of respondents' evaluation for psychomotor domain questions

Teachers believed that TVE students develop better skills in SBL than in WBL programmes. For example, SBL provided better opportunities for students to improve their writing skills (Q1), implement practical tasks individually, such as machine setting and operation (Q6 and Q13), use and manage new technology in implementing practical tasks (Q34 and Q37), and manage and relate theoretical learning to practical applications (Q35 and Q42). In total, almost half of the teachers believed that physical skills (such as operating different machines and applying knowledge in practice) are delivered well in the practical application modules during SBL. However, the other half indicated that psychomotor domain skills in SBL were not designed to support the specific workplace proficiencies in WBL.

Industrial supervisors showed that TVE students performed well in the following psychomotor domain skills: plan and implement and engineering projects (Q15), set time for completing the projects (Q31), work with others in projects (Q38), and become leaders during the practical activities of the project in WBL (Q42). They confirmed that WBL environment allowed TVE students to involve in real work applications and to plan and complete certain engineering projects.

The responses from HR specialists indicated that there were still some psychomotor skills requirements which are needed by the industry which were not acquired by TVE students in WBL programmes. The specific skills are related to specific technical and practical skills, generate new ideas during practical tasks (Q30), and follow appropriate procedures in practical applications (Q33).

From the above analysis, there is a noticeable skills gap between what the TVE system currently offers in SBL and WBL and what the industry requires. In total, the respondents agreed that industries in Bahrain are facing a number of challenges such as shortfalls in students' cognitive, affective, and psychomotor skills. Figure 3.10 shows the skills shortages in the TVE system compared to the modern industrial skills requirements. The figure shows that the employability skills required by industry exceed the levels acquired by TVE students in SBL and WBL programmes. Although the TVE system in Bahrain had served a number of visible needs in the existing labour market (companies which train the students during WBL programmes), there were also other skill needs which were not being met.

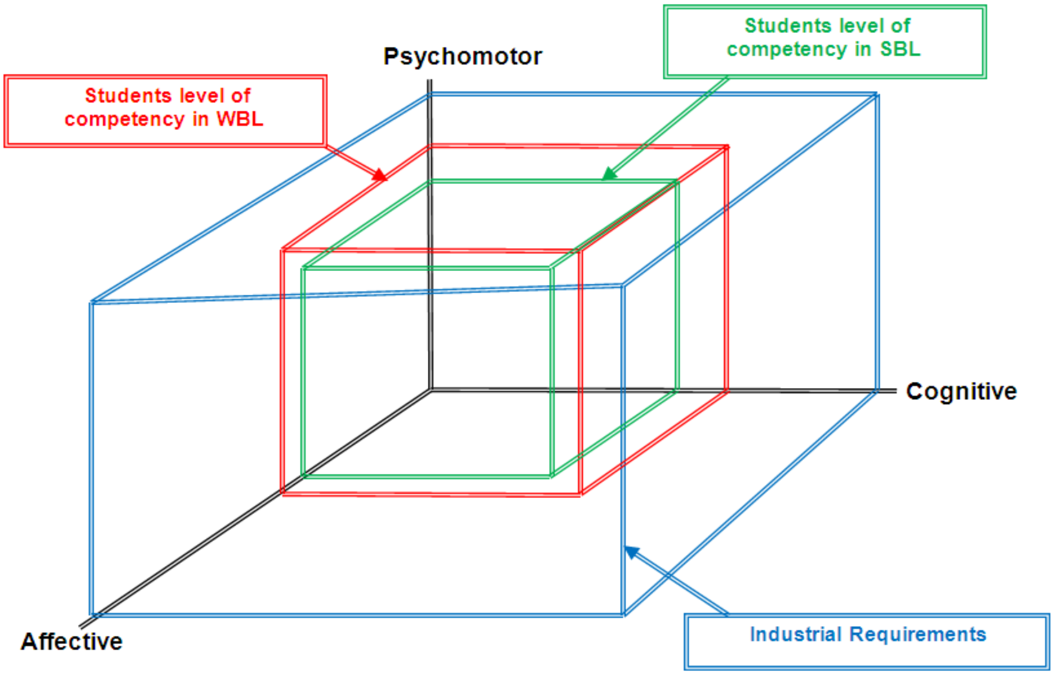

Figure 3.10: The skills shortages in the TVE system

3.3.3 Responses to Part 3

Part 3 was included to encourage a full, meaningful answer using the subjects' own knowledge and/or feelings that could not be expressed when they have answered questions included in Part 1 and Part 2. The respondents raised a number of valuable points, categorised as follows:

• *The skills level within SBL and WBL programmes.* Some teachers and industrial supervisors stated that the students' ability to understand various competencies and apply them in practice during SBL and WBL is questionable. Therefore, embedding the required skills in engineering courses with effective teaching and learning processes become essential. It is necessary to provide opportunities for work experience to TVE students in SBL programmes before they go for WBL programme in industry.

• *Students' attitude in WBL programme.* Some respondents agreed that students' affective domain skills were slightly improved in the WBL compared to the SBL; however, the level of affective skills required by industry has not been achieved yet. The SBL and the WBL programmes should be delivered in a corporate learning environment which could improve students' positive attitude to change, self-esteem, self-confidence, and motivation. The respondents also agreed that the affective domain skills which are relevant to emotional intelligence, cultural awareness, social skills, reflection, and workplace proficiencies should be also acquired during the SBL and applied in the WBL.

• *Engineering attributes.* The respondents summarised some important attributes that are required from TVE students. They agreed that the learning content in SBL should complement the WBL programmes to improve students' ability to apply knowledge into practical and technical competencies, and therefore, acquire professional and ethical responsibilities. They added the importance of commitment to work, social engagement and cultural attributes. All the attributes mentioned should be integrated within the content of the engineering courses in SBL; effective teaching and learning processes in an appropriate learning environment should also be introduced.

• *Size of skills gap.* Respondents stressed that the employability skills gap might be increased by instability and rapid change in the global economy. Lindorff (2011) confirmed that the skills gap might increase due to external pressures from the changing nature of business and asked for new skills and requirements from TVE graduates. Therefore, employee skills are crucial to business success in today's competitive knowledge-driven marketplace.

3.4 The Rationale for Developing an Employability Skills Training Model

The employability skills models discussed in literature were related to various countries that the TVE system in Bahrain was benchmarked against their educational systems. The extensive review had indicated that the available employability skills models could be used to benchmark the performance of students and the main conclusions of the critical appraisal of the existing publications related to employability skills models are as follows:

- Kearns (2001) proposed an improved version of Mayer's model which divided the employers' skills requirements to work readiness and work habits, interpersonal skills and enterprise, innovation and creativity skills, and learning, thinking and adaptability.
- Gibb (2004) added new sets of skills recommended by the industry as for future needs, including involvement in community services, citizenship and knowledge and skills.

- The NCVQ model contained the skills required from students in the 16-19 year age group.
- Dacre and Sewel (2007) proposed an extended version of the NCVQ model which included generic skills, emotional intelligence, career development learning, experience from work and life, reflection and evaluation, and self-esteem and self-confidence.
- Curtis and Mckenzie (2001) published a workplace model which contained foundation skills (basic and thinking skills, personal qualities) and workplace *'know-how'* competencies (resources, information, systems, technology, interpersonal skills).

Then, the employability skills were categorised into three main criteria, cognitive skills, affective skills, and psychomotor skills. It was obvious that they were generic and not focused on the TVE system in Bahrain. Also, they did not meet the modern skills requirements by the industry.

A new model for employability skills is proposed, to focus on the TVE (internal) objectives and industrial (external) requirements. The responses to Questionnaire 1 have shown the skills requirements of modern industry into three main criteria, cognitive skills, affective skills, and psychomotor skills:

- Cognitive domain skills - such as listening, reading, writing, accessing to information, solving problems, and working in teams.
- Psychomotor domain skills - such as physical skills (machine operation, computer application, device utilisation, and safety standards).
- Affective domain skills - such as cultural awareness, social skills attitude, emotional intelligence, and reflection skills.

The novel employability skills training model would give more strength to the existing SBL and WBL and better use of SBL-to-WBL transition as mentioned below:

a) SBL in the TVE system aims to:

- Provide strong general education modules such as Arabic, Maths, English and Science.
- Provide specialised technical practical modules related to students' specialisations, such as electrical and electronic engineering.
- Use competency-based assessment of practical modules.

b) WBL in the TVE system aims to:

- Increase job prospects of TVE graduates.
- Provide actual work experience.
- Receive relevant feedback from industry regarding students' proficiencies.
- Meet with people from different cultures.

c) Best use of the SBL to WBL transition period (September – January in Year 3) in the TVE system. The students usually go to work placement between 1 February – 15 March (6 weeks) and it is necessary to improve the curriculum for the transition period so they are better equipped when they start to work in industry with their supervisors.

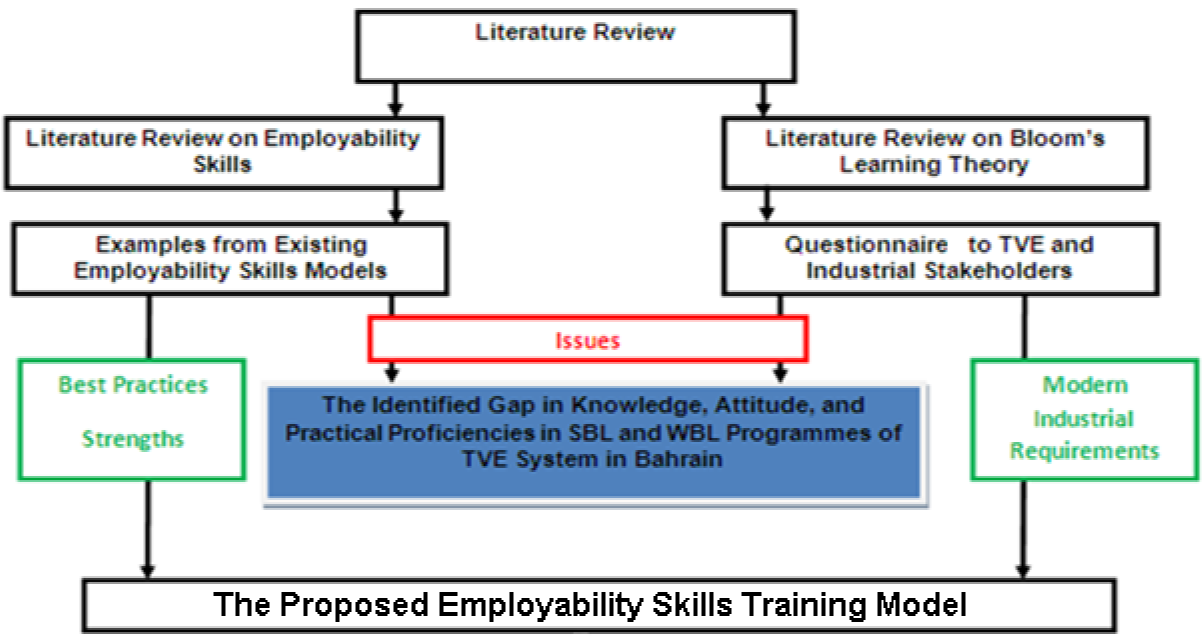

Figure 3.11: The process for proposing the employability skills training model

Figure 3.11 shows the process for proposing a specific employability skills model. The critical appraisal of the existing publications related to employability skills models and Bloom's domains and the analysis of the responses to Questionnaire 1 have contributed to the development of the novel employability skills model.

The next section presents the new proposed employability skills model. The overall aim of the model is to incorporate the skills related to cognitive, affective, and psychomotor domains in engineering courses. It also aims to meet modern industrial skills needs. The new model addresses different learning opportunities to determine the fundamental skills needed and develop strong knowledge, practical skills and a work ethic. In terms of industrial needs, the new model sustains contact between the TVE system and Bahrain's industry as well as providing relevant and up-to-date skills to be gained by TVE students. The model identifies the required skills to be delivered through SBL, WBL and the SBL-to-WBL transition (i.e. it minimises the identified skills gap through modification of the SBL and WBL structures in a typical TVE system).

3.5 The Proposed Employability Skills Training Model

From the above theoretical foundation along with best practice from literature, it is clear that the industrial labour market is becoming global and knowledge based, where specific employability skills related to knowledge and attitude, and these skills should be critically sustained and justified (Zaharim, et al., 2010).

Figure 3.12 contains the diagram of the proposed employability skills training model which is based on pedagogical underpinnings and contained a mixture of cognitive, affective and psychomotor skills. The model incorporated of three categories, namely cognitive and psychomotor skills, affective skills, and specific work related skills. Each category of the model has several components offering sophisticated information about the nature of the employability skills that should be gained by TVE students.

In addition, the model provides an original contribution to the design process of engineering courses, relating to the learning levels of Bloom's domains. For example, in acquiring soft skills related to improving cognitive proficiencies, Bloom's cognitive learning levels should be employed sequentially in teaching the identified and specific skills effectively.

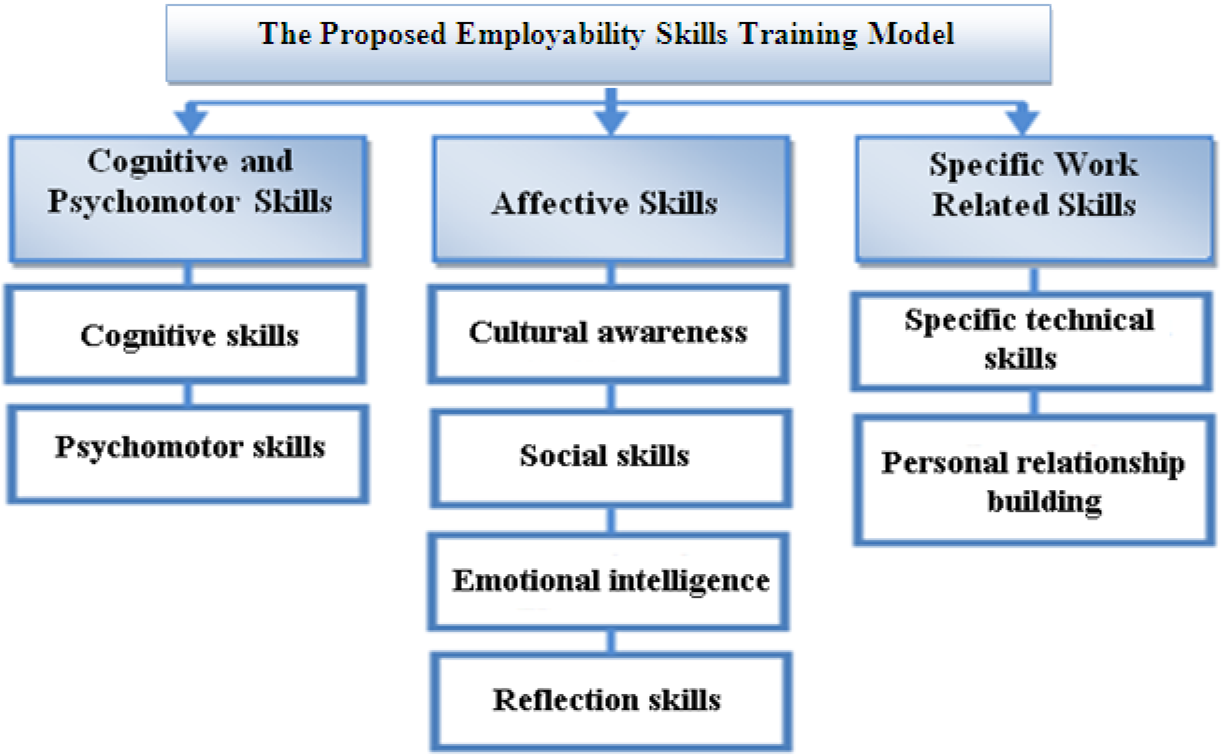

Figure 3.12: The proposed employability skills training model

3.5.1 Category 1 - Cognitive and Psychomotor Skills

This is where TVE students demonstrate basic proficiencies in theoretical modules and convert them into applied proficiencies in practical SBL modules. Wagiran (2008) confirmed that skills should be taught as well as embedded in the learning resources. This category of the proposed model is extremely important in designing learning activities related to cognitive skills (knowledge understanding) and psychomotor skills (technical and physical applications). So, the cognitive learning resources should improve TVE students' thinking skills in order to be more creative and productive during SBL's theoretical and practical modules.

The cognitive skills are the knowledge proficiencies required for high job performance (Robinson, 2000). Specific elements that should be employed in the learning content to achieve learning objectives are recall data, understand, apply, analyse, evaluate, and create (Krathwohl, 2002). To overcome the skills shortages analysed earlier, the cognitive skills rely on knowledge acquisition, and examples of specific activities are presented below:

- Sufficient engagement in dialogues such as listening and asking questions, reading, writing clear statements, and accessing information.

- The principles and examples for understanding how to solve problems. This can be obtained by identifying the problem, understanding it, and applying effective solutions.
- The identification of the concept of team working and understanding how to be involved in group learning activities.
- The identification of engineering principles by understanding them, and applying numeracy and mathematics to engineering principles.
- The use of ICT skills in the learning process and applying them in the workplace.

Even though cognitive skills are vitally important, psychomotor skills are also of critical concern. During the practical work (practical activities and modules in SBL), TVE students should convert their basic skills of knowledge into hands-on applied and technical proficiencies. For example, the necessary knowledge proficiencies which should be learnt in theoretical learning resources are transferred to effective engineering techniques and practice for machine operation, computer applications, safety standards, and device utilisation. Zaharim et al. (2010) added that TVE students should have the ability to transfer their cognitive understanding to the use of engineering technical and physical skills in practice, perform work to the required standards, test components, and assemble equipment according to practical work instructions. So, proficiency from SBL practical work should be applied to deductive and productive technical skills during the practical implementation of the WBL programmes. The learning levels that should be employed in learning resources to achieve proficiency in the technical skills outlined above are observing, performing, demonstrating, constructing and designing (Anderson and Krathwohl, 2001).

3.5.2 Category 2 - Affective Skills

After developing the skills related to cognitive and psychomotor domains in SBL, the affective skills should convert them into psychological understanding of attitudes towards cultural, social, emotional, and reflective issues. Skills deficiencies related to attitude were identified as the most critical and strongly recommended by industry in Bahrain (Mishra et al., 2009). Based on researcher's personal experience, the transition from SBL-to-WBL was not used effectively in TVE because the students attend only one day seminar in order to prepare them to go for work placement. The researcher has designed a new module which was included in the SBL curriculum in the transition period, which contains teaching and learning processes enabling the development of skills from affective domain as well as cognitive and psychomotor domains. The details about this module are presented in Chapter 6.

This new category was included in the proposed employability skills model. There are four main attitude components regarded by modern industry as of vital importance:

- **Cultural Awareness Attitude** – defined as being prepared to understand others' behaviour and to react in a positive manner to cross-cultural differences (Quappe and Cantatore, 2007). It is the basic element that students should recognise in the world of work. It should enable students to make a better contribution during WBL programmes and help them to understand others' behaviour, values and beliefs.
- **Social Skills Attitude** – encouraged students to participate with other people in the workplace, with the right attitude. Social skills are relevant to the workplace, and involve learning about organisational systems: proficiencies related to a company's mission and vision, organisational structure, communication channels among people, people's role in an organisation, obligation to clients and customers, and management of information.
- **Emotional Intelligence Attitude** – motivates students and improves their personal qualities. It also helps in their intellectual growth and recognition of feelings. Emotionally intelligent students can motivate themselves and manage their emotions in relationships with others during the process of work (Dacre and Sewell, 2007).
- **Reflection Skills Attitude** – after students have learnt how to handle with other people in the workplace, they are encouraged to implement various learning activities, and are motivated during their work. This category encourages students to critically analyse and evaluate the learning level of their performance and to write reflective statements. It encourages students to improve their attitudes, values, and behaviours in the workplace environment. This can be specifically carried out by self-development, career development, and self-assessment.

3.5.3 Category 3 - Specific Work-related Skills

These skills should be the outputs of cognitive, affective, and psychomotor skills developed in SBL and SBL-to-WBL transition and should be demonstrated in WBL. The specific work-related skills mainly concern TVE students' performance in analysing practical situations using previous knowledge and attitudes from SBL, in gaining specific industrial skills, and in producing high quality work during WBL. Components are specific technical skills and demonstrating interpersonal relationship-building in the real workplace:

- **Specific Technical Skills** – referred to TVE students' ability to be productive, bring added value to work, and suggest new practical approaches in different engineering projects in the workplace. Basically, the cognitive, affective, and psychomotor skills assist TVE students to convert the knowledge proficiencies, technical skills, and attitude acquisition to specific physical and practical applications in engineering projects during WBL programmes.
- **Personal Relationship Building** – TVE students should be involved in team working, leadership, negotiation skills, work ethics, communication, and should respect others' opinions, and beliefs and backgrounds. These skills, knowledge and attitudes should be used in the planning, implementing, and evaluation phases of engineering projects during WBL programmes.

3.6 Summary

This chapter described the development of a novel employability skills training model based on the results of quantitative and qualitative analysis of the responses to Questionnaire 1 by the teachers from TVE institutions, industrial supervisors and HR specialists from industry. The skills gap was identified between SBL, WBL programmes and industry requirements.

The novel employability skills training model was proposed and could be used for structuring the content of engineering courses in the TVE system with respect to cognitive, affective, and psychomotor skills. The model has incorporated components and the categories for developing learning resources for engineering courses. The three categories of the new model were easily organised and were important because they complement each other.

This model provided an original contribution to the design process of engineering courses in the TVE system in Bahrain. It also included employability skills for the future which are repetitively requested by the modern industry. So, in the long-term, the engineering courses included in the TVE curriculum will create the skilled and educated workforce that will be required to help driving sustainable economic growth.

The researcher has published the following papers which are related to this chapter content:

- An improved employability skills training model and its compliance through vocational educational system in Bahrain, The International Journal of Learning, volume 16.
- Determination of the Effectiveness of Technical and Vocational Education (TVE) by Using Benchmarks from Industrial Requirements, The 4th International Benchmarking Conference, Manama, Bahrain from 27-28 October 2009.
- Identification of Skills Gap Between School-based Learning and Work-based Learning in Technical and Vocational Education in Bahrain, School of Computing and Engineering Researchers' Conference, University of Huddersfield, U.K in December 2009.

The next chapter presents the review and development of two-dimensional models for cognitive, affective and psychomotor domains skills.

CHAPTER 4 - The Two-Dimensional Models for Cognitive, Affective and Psychomotor Domains

This chapter presents the design and development of two-dimensional (2D) models for cognitive, affective and psychomotor domains. These models are used for the design of learning activities to be incorporated in curriculum as the employability skills could be obtained.

The first section analyses the revised 2D model for the cognitive domain developed by Anderson and Krathwohl (2001) on the basis of Bloom's taxonomy and then added new categories of cognitive processes (fact, concept, procedure, metacognitive/strategy). The researcher used the revised 2D model when designing the learning activities for SWT module.

The second section describes the development of the proposed 2D model for affective domain which will be used in the design of learning activities for SWT module in order to fulfil the industry skills requirements identified in Chapter 3. The 2D model contains the original taxonomy presented by Anderson and Krathwohl (2001) and a new dimension derived from the proposed employability skills model.

The analysis of the responses to Questionnaire 1 (included in Chapter 3) showed that the people from industry put a lot of emphasis on the affective domain skills. Unfortunately the existing modules (engineering courses) do not enable the development of affective domain skills. Recent progress on educational research (Russel, 2004; Francis and Green, 2006) has shown that the students' individual performance is influenced by the affective domain skills (including values, beliefs, behaviours, and attitudes).

The third section describes the development of the revised 2D model for psychomotor domain which will be used in the design of learning activities for SWT module in order to fulfil the industry skills requirements identified in Chapter 3. The 2D model contains the Bloom's taxonomy and a new dimension derived from Gagné's (1985) instructional learning theory. The dimensions are correlated to find a way to structure the psychomotor skills learning objectives and activities.

4.1 The Revised Two-Dimensional Model for Cognitive Domain Skills

Anderson and Krathwohl (2001) derived a new version of Bloom's cognitive taxonomy. Then Krathwohl (2002) has organised the cumulative hierarchy where each level has specific verbs to describe the learning objectives and activities. The researcher has combined the conclusions of the two publications and added new verbs in Figure 4.1, which represents one dimension of the revised 2D model of the cognitive domain.

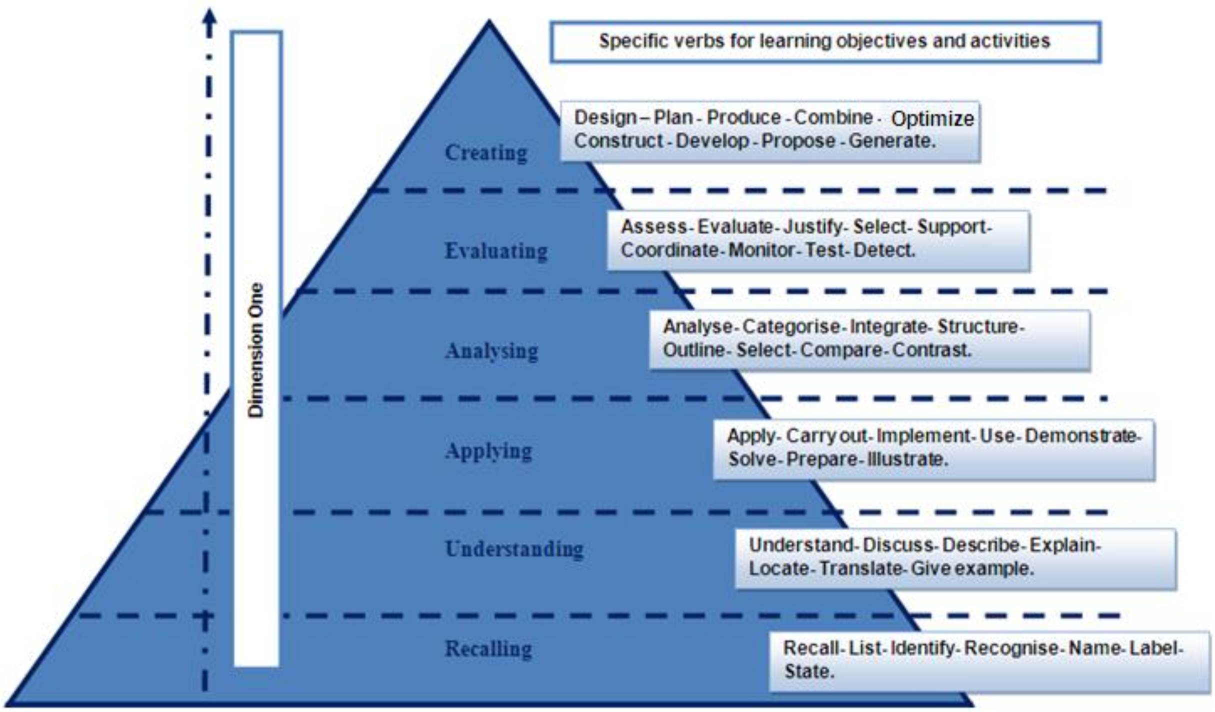

Figure 4.1: One dimension of the revised 2D model of cognitive domain skills

The second dimension was added by Anderson and Krathwohl (2001) to categorise the type of knowledge that should be learnt. This new knowledge dimension takes into account the impact of teaching and learning, and includes factual, conceptual, procedural and meta-cognition knowledge.

Table 4.1 shows the correlation between the two dimensions. The first dimension, the original cognitive domain, is known as the cognitive process, and is represented by the six horizontal levels. The second dimension is the new knowledge dimension, represented vertically with the types of knowledge being learnt, and divided into facts, concepts, procedures and strategies.

Table 4.1: The revised 2D model for the cognitive domain (Adopted from Dalton, 2003)

Category of cognitive process being employed in the content / *Category of knowledge being learnt*	**Recalling**	**Understanding**	**Applying**	**Analysing**	**Evaluating**	**Creating**
Fact	Recall facts	Understand facts	Apply facts	Analyse facts	Evaluate facts	Create facts
Concept	Recall concepts	Understand concepts	Apply concepts	Analyse concepts	Evaluate concepts	Create concepts
Procedure	Recall procedures	Understand procedures	Apply procedures	Analyse procedures	Evaluate procedures	Create procedures
Metacognitive/Strategy	Recall strategies	Understand strategies	Apply strategies	Analyse strategies	Evaluate strategies	Create strategies

The next step is to develop learning activities in SWT module based on the revised 2D model for the cognitive domain in order to fulfill the identified skills requirements for TVE system and industry. The two dimensions are the knowledge dimension and cognitive process and the new cognitive proficiencies are used to categorise the learning objectives.

The researcher has used the revised 2D model to formulate learning objectives and activities for SWT module which enable the development of cognitive skills (see Table 4.2).
Regarding the cognitive process, the learning levels (LL) correspond to Bloom's taxonomy:
LL1: Remember previously learnt knowledge and locate knowledge in long-term memory.
LL2: Use knowledge to understand new learning activities.
LL3: Apply the identified information and learning activities in designing an experiment.
LL4: Categorise the learning activities into parts and structure the parts to the whole.
LL5: Detect the most suitable method for solving the problems in the learning activities.
LL6: Put information together and plan the learning activities in a new structure.

Regarding the knowledge dimension – the learning activities should be based on the following:
- Facts: the learning activities are based on basic and reliable sources of information.
- Concepts: the knowledge is structured on learning theories and has been related to information.
- Procedures: The information is structured into procedures.
- Strategy: The information is organised systematically and specifically.

Table 4.2 shows that each of the four knowledge categories has a matrix correlation with the six learning levels. For example, to obtain the learning objectives in factual knowledge, students should listen to dialogues (identifying new experience), discuss the information in dialogues with other students (understanding), use the information in practical work procedures (applying), analyse facts that were obtained from dialogues and practice (analysing), evaluate facts (evaluating), and develop them (creating).

The revised 2D model of cognitive domain could be used by educators in structuring cognitive learning activities for engineering courses. In this way it will be considered the correlation between the hierarchical sequence of the original Bloom's taxonomy and the identified cognitive skills which are required by industry.

Table 4.2: Using the revised 2D model for the cognitive domain for the development of learning activities

Category of cognitive process being employed in the content / ***Category of knowledge being learnt***	**LL1:Recalling** Recall- List- Identify- Recognise- Name- Label- State.	**LL2:Understanding** Understand- Discuss- Describe- Explain- Locate- Translate- Give example.	**LL3:Applying** Apply- Carry out- Implement- Use- Demonstrate- Solve- Prepare- Illustrate.	**LL4:Analysing** Analyse- Categorise- Integrate- Structure- Outline- Select- Compare- Contrast.	**LL5:Evaluating** Assess- Evaluate- Justify- Select- Support- Coordinate- Monitor- Test- Detect.	**LL6:Creating** Design – Plan - Produce - Combine - Construct - Develop - Propose - Generate.
Fact	**Listen to dialogues**	**Discuss the information in dialogues**	**Use the information in practice**	**Analyse facts that were obtained from dialogues**	**Evaluate facts**	**Develop facts that were obtained theoretically and practically**
Concept	**Identify engineering concepts**	**Describe theoretical engineering principles**	**Demonstrate the engineering principles in practical applications**	**Analyse engineering principles**	**Justify engineering principles theoretically**	**Combine engineering principles for practical applications**
Procedure	**Identify the problem**	**Understand the problems solving procedures** **Understand how to work in teams**	**Apply procedures in practical work applications individually and in groups**	**Integrate new knowledge to solve the problems**	**Justify the problem solving procedures**	**Create new work procedures**
Metacognitive/Strategy	**Name a suitable strategy to gain the required knowledge**	**Give examples of problem solving strategies**	**Illustrate new strategies during practical applications**	**Compare strategies for problem solving**	**Assess strategies**	**Generate new strategy for problem solving**

4.2 The Proposed Two-Dimensional Model for Affective Domain Skills

The critical appraisal of the existing publications and the analysis of responses to Questionnaire 1 have shown that the affective domain skills are required by the industry and the exiting engineering curriculum does not enable an acceptable development of these skills.

The researcher has developed a 2D model for affective domain skills which contains the original taxonomy presented by Anderson and Krathwohl (2001) and a new dimension derived from the proposed employability skills training model (see Chapter 3).

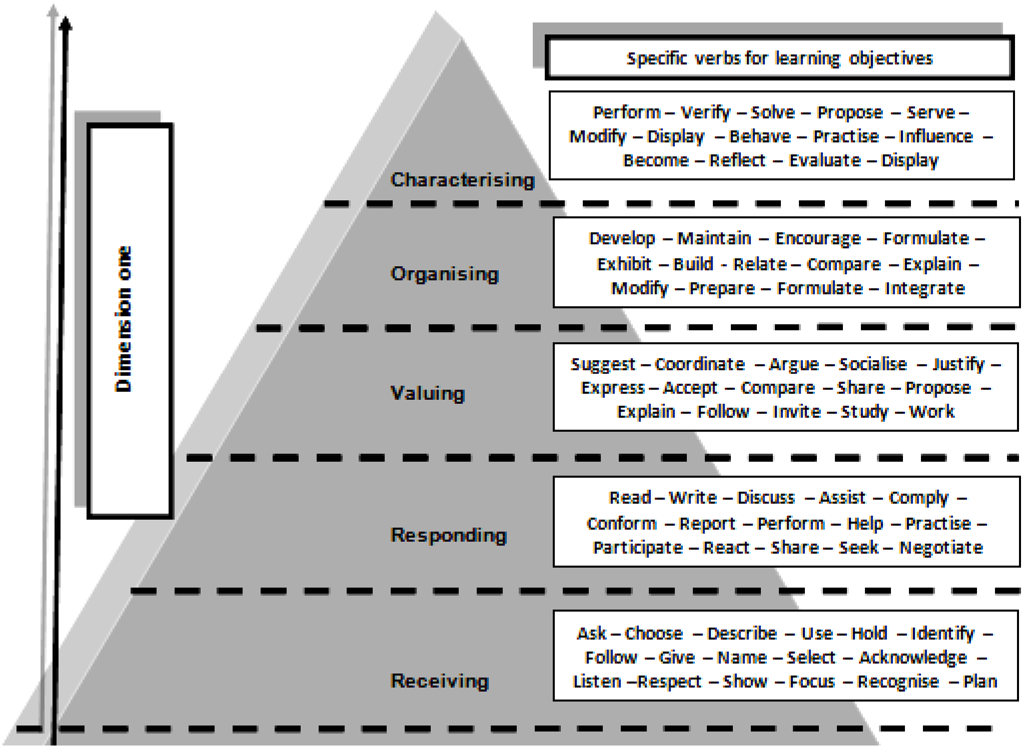

Figure 4.2: One dimension of the proposed 2D model of affective domain skills

The first dimension of the proposed 2D model is the original taxonomy for the affective domain (see Figure 4.2). It is about learning values, attitudes and behaviours, and incorporates five different learning levels. Figure 4.2 represents the affective domain in a cumulative hierarchy, from simple awareness to complex characterisation (Lynch et al., 2009). The cumulative structure starts with students' ability to listen and receive information, to react and respond in a positive manner with other students, to socialise and value a learning situation, to organise the learning situation, and to characterise and reflect positively on the learning situation. Lists of verbs for each learning level were added to this dimension, in designing the affective domain's learning objectives. For example, in designing a learning activity, different action verbs may be used, although the hierarchical sequence must be maintained.

Gable and Wolf (1993) stated that three attributes - intensity, direction and target - should be considered to achieve affective skills objectives in learning activities. For example, during an engineering practical work in the workplace, the learning activities should be designed to increase TVE students' willingness to learn (intensity), have a positive attitude towards other people (direction), and achieve the learning activities' objectives (target). The example shows the importance of the affective domain in achieving practical competencies in engineering courses; for instance, all learning levels must be considered. However, the degree of achievement in affective learning objectives is influenced by individual differences, which may require assessing prior knowledge and allowing for complexity in assessing students' affective characteristics.

The second dimension (see Figure 4.3) of the proposed 2D model for the affective domain was derived from the proposed employability skills training model (see Chapter 3). This dimension contains four main categories, regarded by modern industry as of vital importance. The categories were organised on the basis to develop affective skills in the teaching and learning processes from the simplest attitudes and behaviours to the most complex. The researcher has included various skills into the four categories based on the personal experience in the TVE system in Bahrain and literature review.

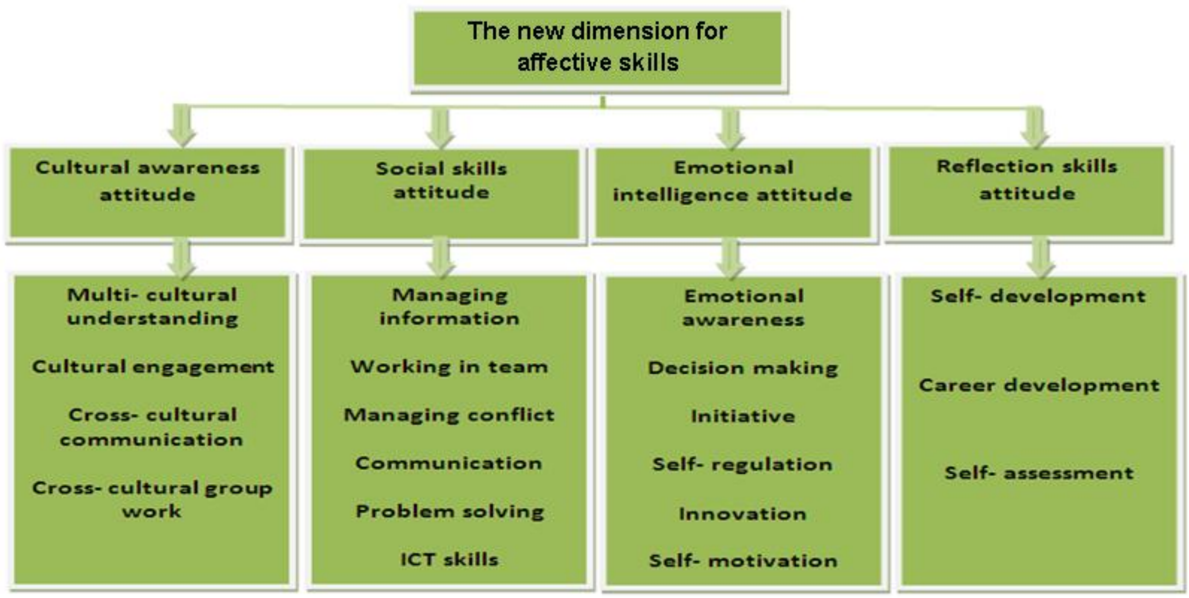

Figure 4.3: Second dimension of the proposed 2D model of affective domain skills

Category 1 - Cultural Awareness Attitude - This is the basic attitude towards other people that students acquire through information and experience during the learning processes (Hall, 2003). Application of this aspect starts with understanding others' behaviour and reacting in a positive manner to cross-cultural differences. Therefore, students should become more culturally understanding and able to share values for a better contribution during the learning process. The cultural awareness category is important because it provides learning challenges based on the differences in behaviours among students. The category contains four different specific skills: multi-cultural understanding, cultural engagement, cross-cultural communication, and cross-cultural group work. They are cumulatively organised to help students understand the concept of multi-cultural awareness by encouraging them to communicate and collaborate in groups with people from other cultures.

The proposed SWT module will contain learning activities aiming to develop the awareness, knowledge and skills to operate in multicultural contexts and across cultural boundaries (see Chapter 6).

Category 2 - Social Skills Attitude - This category encourages students to socially engage with other people in theoretical and practical learning applications; it includes proficiencies related to communication channels, employees' obligations to clients and customers, and management of information. This category contains specific skills for students' social engagement in the learning process: the detailed management of information, working in teams, managing conflict by using communication skills, solving problems during the process of work, and applying ICT skills in practice.

The proposed SWT module will contain learning activities aiming to develop social skills in various contexts. For example, in practising communication skills in class during the theoretical learning activities requesting the students to work in groups, the students first listen to the teacher, communicate verbally with the teacher and other students, present written materials for various tasks and respect the school rules and regulations. In the case of group work activities in the workshop where practical tasks are performed, in addition the students have to practise the communication skills in real life applications (see Chapter 6).

Category 3 - Emotional Intelligence Attitude - The emotional intelligence attitude encourages students' intellectual growth by recognising their emotions and motivating them to improve their personal qualities. This category includes various specific skills, namely emotional awareness, decision making, initiative, self-regulation, innovation, and self-motivation. The specific skills are carefully synchronised to ensure that students recognise their emotions, are able to take decisions in the process of work, demonstrate initiative, have mission and vision, react in a positive manner with other people, and finally suggest new ideas for improvement.

The proposed SWT module will contain learning activities aiming to develop students' emotional intelligence attitude. For example, in one problem-based learning activity, every group of students could be asked to present a final solution to a real life problem after they have searched the relevant sources and discussed within the group and reached a final decision (see Chapter 6).

Category 4 - Reflective Skills Attitude - Having mastered the previous skills, students are encouraged to critically analyse and evaluate the learning level of their performance and to write reflective statements, and to improve their attitudes, values, and behaviours in the learning environment. This contains the following specific skills, self-development, career development and self-assessment. It is important for the TVE students to be able to reflect and self-assess their own learning in order to take intentional steps toward developing their professional expertise and engage in lifelong learning. Hampton and Morrow (2003) showed that the use of reflective journals for engineering courses had positive influence on students' self-awareness, interest and perceptions of learning.

The proposed SWT module will contain learning activities aiming to develop students' reflection skills. For example, one learning activity requests the students to watch a video showing the operation of a real machine from the workshop and analyse the influence of various parameters over the machine operation. Then the students are performing practical tasks with the real machine from the workshop and are asked to complete a survey containing questions related to the self-evaluation of their learning and successful behavioural outcomes (see Chapter 6).

Table 4.3 shows how the original taxonomy presented by Anderson and Krathwohl (2001) and the new dimension derived from the proposed employability skills training model are combined in order to obtain the proposed 2D model for affective domain. It can be seen that each of the four identified affective categories has a matrix correlation with the five learning levels. For example, to obtain the learning objectives in the category social skills attitude, students should have access to information (receiving new experience), participate actively in work objectives with other students (responding), negotiate work procedures with other students (valuing), build strong relationships with other students in the process of work (organising), solve disagreements and have open discussions in the process of work (characterising). Again, the example illustrates that the model is intended as a guideline for educators and that the hierarchical sequence and the identified industrial needs must be considered. Also the developed model is flexible and allows possibilities for designing different learning activities.

Table 4.3: The developed 2D model for affective domain skills

Category of affective process being employed / ***Category of attitude being developed***	**Receiving**	**Responding**	**Valuing**	**Organising**	**Characterising**
Cultural Awareness Attitude	Acknowledge people's behaviours values, and believes	React in a positive manner to cross-cultural differences	Justify between various aspects of cultural values	Compare between various aspects of cultural values	Display the various aspects of cultural values in the workplace and real life applications
Social Skills Attitude	Access to information	Participate actively in work objectives with other people	Negotiate work procedures with other people	Build strong relationships with other people	Solve disagreements and have open discussions
Emotional intelligence Attitude	Feel your emotions	Respond to your emotions	Recognise and understand other people's emotions	Develop relationships with other people	Influence the managed relationships with other people
Reflection Skills Attitude	Receive various information and skills	Clarify personal and future targets based on the received skills	Argue with other people the personal and future targets based on the received skills	Develop Portfolio containing the managed skills and formulate a personal C.V.	Practice the managed skills in real life applications

The proposed 2D model gives guidance for structuring affective skills learning activities in accordance with the identified needs of modern industry. So the affective learning objectives should be formulated with respect to prior knowledge and technical capabilities (Alseddiqi and Mishra, 2011a). Table 4.4 presents the use of the proposed 2D model for the affective domain for the development of learning activities. In this way it will be considered the correlation between the hierarchical sequence of the original Bloom's taxonomy and the identified affective skills which are required by industry.

Table 4.4: Using the proposed 2D model for the affective domain for the development of learning activities						
No	**Name of Facet**	**Specific Competency/Skills of Facet**				
Cultural Awareness Attitude		**Receiving**	**Responding**	**Valuing**	**Organising**	**Characterising**
1	Multi-cultural understanding	Students acknowledge other peoples' culture	Students recognise people from other cultures	Students have positive attitude towards people from other cultures	Students develop their personal values and believes	Students behave consistently with personal values
2	Cultural engagement	Students attend cultural events/venues	Students like participating in groups of people from different backgrounds in school and during work placement	Students value people as individual cases	Students develop good rapport with people from other cultures	Students solve conflicts with other people
3	Cross-cultural communication	Students listen actively to other people's believes	Students have positive discussion with people from different backgrounds	Students accept arguments and share information	Students maintain good relationships with people from other cultures	Students communicate actively in the process of work with other people
4	Cross-cultural group work	Students respect others participations in work	Students react in positive manner with others in the process of work	Students enjoy working with multicultural team	Students encourage people in group working	Students solve problems of work in group discussions
Social skills Attitude		**Receiving**	**Responding**	**Valuing**	**Organising**	**Characterising**
5	Managing information	Students acknowledge how to access and find information	Students participate actively in following work instructions	Students negotiate work procedures with other people	Students arrange various kind of information for the process of work	Students display the managed information in reflection statements
6	Communication skills	Students listen to teachers in the class and during practical tasks	Students communicate well with teachers and students in the class and during practical tasks	Students represent written materials for various tasks	Students respect rules and regulations in both environments, school and workplace	Students practise communication skills in real life applications
7	Working in team	Students like becoming a member of a team	Students participate actively in team's discussion	Students coordinate the activities in the team work	Students build strong relationships with the team members	Students reflect on their experience in the team work
8	Problem solving	Students observe how to solve problems	Students clarify how to solve problems	Students argue on solutions for solving problems	Students compare solutions to other available answers	Students behave as an independent problem solver

9	Managing conflict	Students recognise different disagreements situations	Students negotiate conflicts/disagreements with other people	Students suggest new solutions for solving conflicts	Students encourage with other people in group discussions	Students practise the new and agreed solutions for managing conflicts
10	ICT skills	Students acknowledge the importance of ICT skill	Students interact with teachers and students in using technology	Students socialise with students in learning activities using technology	Students apply information technology to build knowledge	Students like collaboratively sharing ideas, and challenging each other by posing problem
Emotional intelligence Attitude		**Receiving**	**Responding**	**Valuing**	**Organising**	**Characterising**
11	Emotional awareness	Students feel their emotions	Students react in a positive manner with other people	Students have the ability to appraise their personal emotions	Students recognise how their feelings affect the work	Students respect others ideas, participations and opinions
12	Decision making	Students acknowledge the importance of taking decisions at work	Students discuss the importance of decision making process with other people	Students suggest decision making strategy	Students formulate decision making strategy for work	Students practise the decision making strategy in work as well as real life applications
13	Initiative	Students focus on the organisational vision and mission	Students share the organisational vision and mission with other people	Students plan the work procedures with other people	Students arrange new work procedures and share it with other people	Students influence other people to solve work problems and improve work procedures
14	Self-regulation	Students show interest in learning activities	Students react positively in implementing learning activities	Students compare their performance in learning activities with other students	Students exhibit their mistakes in open discussions	Students become proactive learner
15	Innovative	Students listen to different ideas for work improvement	Students seek new ideas	Students justify new ideas and opinions	Students build their work on the generated new ideas	Students use new ideas in problem solving process
16	Self-motivation	Students focus towards achieving the organisational goals and objectives	Students seek opportunities in achieving work outcomes with other student	Students attach their values in working individually and in teams	Students are being committed to continuous improvement in work	Students practise their motivational values at work and life

Reflection skills Attitude		Receiving	Responding	Valuing	Organising	Characterising
17	Self-development	Students listen to other people advices	Students share their personal experience in group's discussion	Students have positive attitude to develop themselves	Students always value their progress and discuss with others	Students practise their abilities to plan for future
18	Career development	Students plan their personal and future career	Students set achievable goals during their career	Students justify their values and show interest in developing their skills	Students develop their C.V	Students reflect their experience in their future work
19	Self-assessment	Students acknowledge their strengths and weaknesses	Students write their portfolio with extra care with evidence of their skills and abilities	Students express their personal views and opinions	Students prioritise their personal views and opinions	Students evaluate their learning experience and relate it to real life practices

4.3 The Revised Two-Dimensional Model for Psychomotor Domain Skills

Bloom's original theory for the psychomotor domain addressed skills development that are related to practical applications and added five learning levels with physical movement skills to the action verbs of the learning levels. Figure 4.4 shows Bloom's original psychomotor domain which has a cumulative hierarchy from the simplest learning level skills (observing) to the most complex (designing). Each level has different specific verbs for learning objectives and activities.

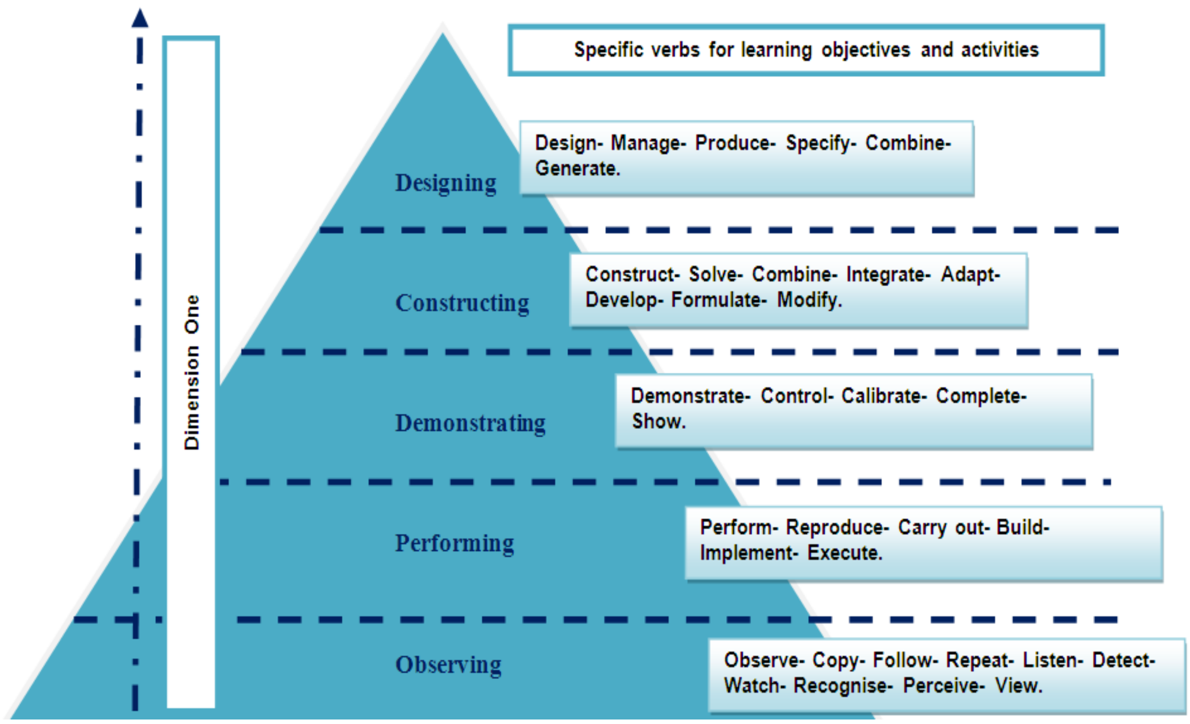

Figure 4.4: One dimension of the revised 2D model of psychomotor domain skills

Krathwohl (2002) presented examples of specific learning objectives and activities related to each learning level:

- *Observing*: students observe the teacher who is usually more experienced than them. They watch the teacher demonstrate a practical learning application and may repeat the demonstration themselves.
- *Performing*: by referring to previous experience or to written or verbal instructions, the students carry out a practical learning exercise, converting the acquired or memorised knowledge into physical skills.
- *Demonstrating*: students complete a practical learning exercise with or without direct instructions, individually or in groups, depending on the learning scenario. At this level, the students acquire psychomotor skills, but are still not proficient.

- *Constructing*: students combine associated learning activities to meet novel requirements, performing different physical activities to integrate the work.
- *Designing*: after combining the associated learning activities, the students might generate minor changes and plan a new strategy for improvement.

Moving from a one-dimension to a 2D model for psychomotor domain skills required a new category for the learning condition of the skills that should be developed with or without direct instructions. From this point, an important contribution was presented by Gagné (1985) in his instructional learning theory where he divided the conditions of learning into two categories, namely internal and external. The internal condition of learning is based on what the students already know and use knowledge and experience acquired previously in their practical activities and exercises. The external condition of learning is based on what is presented to the students to demonstrate practical learning activities and exercises. So Gagné's instructional theory made an attempt to relate both internal and external conditions to the outcomes leading to appropriate enhancement of learning.

Table 4.5: The 2D model for psychomotor domain skills

Category of psychomotor process being employed	**Observing**	**Performing**	**Demonstrating**	**Constructing**	**Designing**
Category of skills condition being learnt					
Internal	Observing internally	Performing internally	Demonstrating internally	Constructing internally	Designing internally
External	Observing externally	Performing externally	Demonstrating externally	Constructing externally	Designing externally

The researcher combined Bloom's original psychomotor domain and Gagné's conditions of learning in order to develop the revised 2D model for psychomotor domain skills (see Table 4.5). In this 2D model, dimension one is the category of psychomotor process being employed, with the addition of the new dimension related to the internal or external conditions in which the skills are developed. Each of these two learning conditions has a matrix correlation with the five learning levels.

Table 4.6 shows the correlations between the two dimensions, using the revised 2D model for the psychomotor domain for the development of learning activities. For example, SWT module contains learning activities related to the design of electronic circuit diagrams. The first learning activity requires the students to produce one diagram following teacher's instructions (external condition accordingly to Gagné's theory). The second learning activity requires the students to produce another diagram without teacher's instructions (internal condition accordingly to Gagné's theory).

Table 4.6: Using the proposed 2D model for the psychomotor domain for the development of learning activities

Category of psychomotor process being employed / ***Category of skills condition being learnt***	**Observing**	**Performing**	**Demonstrating**	**Constructing**	**Designing**
Internal	Identify an electronic circuit diagram	Build the main stages of the circuit diagram without instructions	Complete the circuit diagram without instructions	Combine the main stages of the circuit diagram with no guidance	Generate new work strategy individually
External	Observe an electronic circuit diagram	Build the main stages of the circuit diagram with instructions	Complete the circuit diagram with instructions	Combine the main stages of the circuit diagram with guidance	Generate new work strategy with other students

Appendix B contains an example from the SWT module where the learning activities are designed based on the 2D models. These activities should enable the development of cognitive, affective, and psychomotor skills of students.

Shephard (2008) confirmed that courses in vocational education should enable the development of affective domain skills along with other proficiencies related to knowledge and technical skills. Lindorff (2011) added an important point for structuring these courses which should provide more opportunities to develop employability skills in order to make the vocational education graduates ready for the labour market.

The 2D models presented in this chapter are a main pillar of the pedagogical framework for aligning the TVE systems learning objectives, teaching and learning methodology, and assessment strategies.

A report produced by JISC (2004) emphasised that the learning activities should be designed to meet internal and external objectives. For example, using the 2D models for curriculum development should aim to achieve TVE educational goals and industry expectations.

4.4 Summary

This chapter described the design and development of 2D models for cognitive, affective and psychomotor domains. These models were used for the design of learning activities which are included in the new proposed SWT module.

The revised 2D model for the cognitive domain was based on Bloom's taxonomy and the categories of cognitive processes (fact, concept, procedure, metacognitive/strategy). The researcher has added new verbs which represented in dimension one.

The proposed 2D model for affective domain contained the original taxonomy presented by Anderson and Krathwohl (2001) and a new dimension derived from the proposed employability skills model.

The revised 2D model for psychomotor domain contained the Bloom's taxonomy and a new dimension derived from Gagné's (1985) instructional learning theory was added by the researcher. The dimensions are correlated to find a way to structure the psychomotor skills learning objectives and activities.

One of the more significant findings to emerge from this chapter was that the 2D models could be used for structuring learning activities in engineering courses so the effectiveness of TVE system would be increased and the students should be better prepared for the job market. So the learning should benefit people emotionally, intellectually, socially and economically and have an important contribution to community sustainability.

The researcher has published the following paper which is related to this chapter content:

- Development of a Two-Dimensional Model for Affective Domain Competencies in Engineering Courses, the 24th International Congress on Condition Monitoring and Diagnostics Engineering Education, COMADEM, Stavanger, Norway from May 30th to 1st June, 2011.

The next chapter presents the correlation between the existing approaches of teaching and learning practised in the TVE system with students' preferred learning styles by using Questionnaire 2.

CHAPTER 5 - User Analysis Related to the Proposed SBL-to-WBL Transition (SWT) Module

This chapter presents the teachers' and students' preferences related to learning activities included in the existing Electrical and Electronic courses (EECs) from four TVE institutions (Sheikh Khalifa, Aljabria, Sheikh Abdulla, and Jidhafs). These were determined by asking a number of 48 teachers and a pilot group of 60 students in Year 2 to complete Questionnaire 2. The purpose was to examine the correlation between the existing approaches of teaching and learning practised in TVE educational environment with students' learning styles. The teachers' and students' responses showed that better learning activities should be included in EECs in order to suit different learning styles.

The final section of this chapter contains examples of various modes of delivery which could be used in the learning activities of the proposed SWT module and the emphasis is on using information technology in the delivery of these learning activities.

TVE Directorate has performed a diagnostic study in 2010 in order to review the effectiveness of the teaching and learning processes (Alseddiqi et al., 2011). It was obvious that the existing teaching and learning strategy did not equip the students with all the skills required by modern industry. Also it has shown several areas which had to be improved so Questionnaire 2 was designed to ask the teachers' and students' opinions about the possible ways of increasing the effectiveness of teaching and learning processes.

Hillier (2009) suggested that the teaching and learning processes should aim to accommodate the variety of students' learning styles. Kolb's learning styles inventory (LSI) (1984) incorporated four learning styles which represent the various needs of individual learners: diverging (feeling and watching); assimilating (thinking and watching); converging (thinking and doing); and accommodating (feeling and doing). These learning styles have been considered when designing the questions included in Questionnaire 2.

Kanninen (2008) indicated that Honey and Mumford learning style stages and Kolb's learning styles are similar and has shown that:

- Activist learning style is similar to the Accommodating learning style.
- Reflector learning style is similar to the Diverging learning style.
- Theorist learning style is similar to the Assimilating learning style.
- Pragmatist learning style is similar to the Converging learning style.

Heywood (2005) recommended that the design and delivery of teaching activities should use the learning content effectively, satisfy and evaluate the individuals' needs, and provide all the possible modes of delivery. Baldwin and Sabry (2010) added that the learning style inventory helped to explore two aspects:

- Provide accurate information on the learning styles that meet the students' knowledge and needs.
- Match the learning styles with the aims, objectives, learning outcomes and activities.

Therefore Questionnaire 2 aimed to find the similarity between the teaching and learning styles from teachers' and students' points of view.

5.1 Questionnaire 2 (User Analysis from Teachers' Perspectives)

This version of Questionnaire 2 (see Table 5.1) was developed to assess the link between the teachers' preferences in organising 20 typical learning activities (see Table 5.1) and the students' learning styles in accordance with Kolb's learning styles inventory (1984).

Table 5.1: Questionnaire 2 (user analysis from teachers' perspectives)

No.	**Learning activity**	***Learning Style A***	***Learning Style B***	***Learning Style C***	***Learning Style D***
1	During the delivery of a new lesson, I concentrate on	Involving students to participate positively in the class ◻	Giving students the time to listen and observe ◻	Giving instructions for critical thinking ◻	Practical tasks and applications ◻
2	When operating new machine for the first time in the workshop, I prefer the students to	Work with other students from the given guidelines ◻	Listen to the teacher, look at all side of required work issues, and concentrate to new experience ◻	Read the manual and understand the work instructions ◻	Try things out individually ◻
3	I believe that the students learn better when they	Study with other colleagues ◻	Write their own notes ◻	Use their imagination and examples ◻	do simulation work ◻
4	The theory lessons normally tend to be	Group discussion learning style ◻	Questions and answers ◻	Self-study ◻	On-line learning style with real work examples ◻
5	The available learning materials include	Films/Videos ◻	Pictures ◻	Animations ◻	Experiments ◻

No.	Learning activity	*Learning Style A*	*Learning Style B*	*Learning Style C*	*Learning Style D*
6	During the delivery of a learning lesson	I divide students to Groups ◻	I invite a guest speakers ◻	I provide critical thinking activities with examples ◻	I provide intelligence questions and answers style ◻
7	The available learning materials contain	Problem solving activities ◻	Group activities ◻	Pictures and videos ◻	Practical sessions ◻
8	During the teaching and learning process, I am the kind of person who	Rely on my experience ◻	Rely on my observations ◻	Rely on my ideas ◻	Do things out by myself ◻
9	When I am explaining something to a student, I prefer to	Give some examples from my experience ◻	Answer question ◻	Be logical ◻	Work practically and get it done ◻
10	During a practical session in the workshop, I am the kind of teacher who	Explain the practical instructions to students ◻	Show the students how to do things out ◻	Let the students to think on how to do things out ◻	Let the students to try things out ◻
11	I use learning materials which contain	Videos ◻	Pictures and diagrams ◻	Charts ◻	Practical sessions ◻
12	I tend to say that, the learning materials help the students to	Use their experience ◻	Watch things ◻	Think about new ideas ◻	Implement tasks ◻
13	I believe students learn faster by	Following instructions and written notes ◻	Listening and asking questions ◻	Giving ideas and examples ◻	doing assignments and practical applications ◻
14	I usually	Divide the class into working groups ◻	Answer questions ◻	Explain things out ◻	Ask students to do the work ◻
15	I usually deliver lessons to students in	Large classroom ◻	Groups ◻	Small classroom ◻	Workshop ◻
16	Students always gain the highest score when they do	Problem solving exercises ◻	True and false questions ◻	Descriptive questions ◻	Practical exercises ◻

No.	Learning activity	*Learning Style A*	*Learning Style B*	*Learning Style C*	*Learning Style D*
17	When I deliver a new learning activities	I explain the information to the students ◻	I divide the students into groups ◻	I let the students to read and think ◻	I let students to try things out ◻
18	During the delivery of a learning lesson, I prefer	Group discussion learning ◻	Face-to-face learning ◻	Self-study learning ◻	On-line learning ◻
19	When I open a new topic to discuss with students, I tend to	Ask questions ◻	Listen and think ◻	Participate in answering the questions ◻	Evaluate the situation ◻
20	I prefer students who are able to	Active in group work ◻	Observe and watch situations ◻	Produce ideas and theories ◻	Able to see and touch objects ◻

Table 5.2 shows a sample of Questionnaire 2 where learning activities are included in rows and the four learning styles are included in columns, A, B, C and D. This sample refers to the teachers' preference when a new lesson is presented:

A. Involving students in participating positively in the class (Accommodating).

B. Giving students the time to listen and observe (Diverging).

C. Giving instructions for critical thinking (Assimilating).

D. Practical tasks and applications (Converging).

Table 5.2: Sample of Questionnaire 2 (user analysis from teachers' perspectives)

No.	Learning activities	*A (Accommodating)*	*B (Diverging)*	*C (Assimilating)*	*D (Converging)*
1	During the delivery of a new lesson, I concentrate on	Involving students to participate positively in the class ◻	Giving students the time to listen and observe ◻	Giving instructions for critical thinking ◻	Practical tasks and application ◻

The teachers were asked to rank their preferences based on a 4-scale:

Grade 1 - Most used mode of delivery

Grade 2 - Good mode of delivery

Grade 3 - Adequate mode of delivery

Grade 4 – Least used mode of delivery

Figure 5.1 shows the distribution of the average values for teachers' responses, each learning activity has a colour code and the *x* axis represents the four learning styles. The respondents ranked each learning activity with regard to the four learning styles, and the average percentage for each possible mode of delivery in every activity is represented along the *y* axis.

For example the distribution of teachers' most used approaches (grade 1) for Learning Activity 2 (operating a new machine for the first time in the workshop) is as follows:

- 19 teachers (39.6%) preferred students to try things out individually – corresponding to converging learning style.
- 13 teachers (27.1%) would ask students to read the manual and understand the work instructions – corresponding to assimilating learning style.
- 12 teachers (25%) preferred students to listen to lectures and ask questions - corresponding to diverging learning style.
- 4 teachers (8.3%) would ask students to work in groups from given guidelines and instructions – corresponding to accommodating learning style.

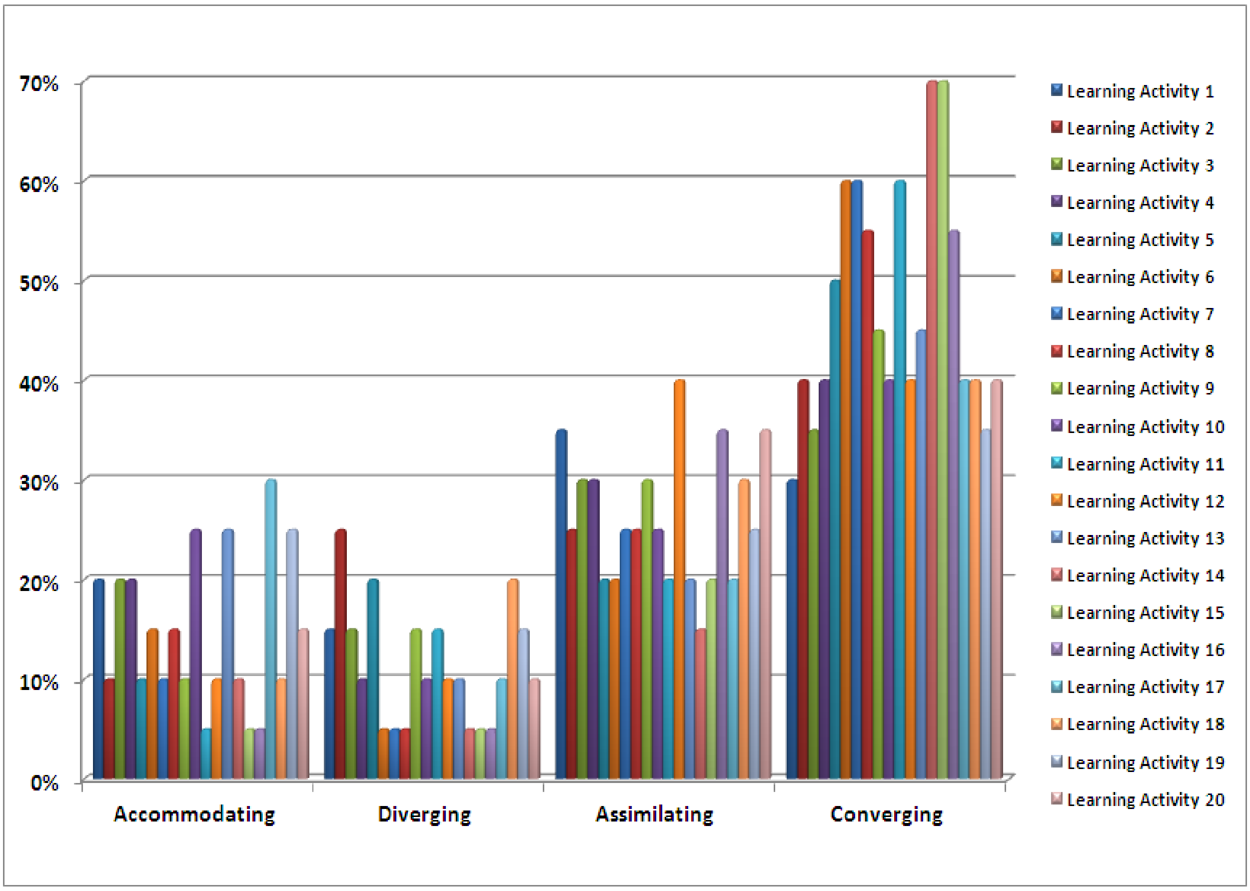

Figure 5.1: Distribution of teachers' most used approaches (grade 1)

Figure 5.2 shows the average values for teachers' most used approaches along the *y* axis, and the *x* axis shows the four learning styles. A number of 27 teachers (56.3 %) prefer to organise and deliver the learning activities in a way which corresponds to converging learning style. This reflects the actual situation within TVE system where the existing learning activities included in the curriculum have been designed mainly to improve students' psychomotor skills, to understand and apply different tasks in practice. Also the teachers could prefer to use the existing learning materials due to limited time they can dedicate for the design of new materials.

A number of 13 teachers (27.1 %) prefer to organise and deliver the learning activities in a way which corresponds to assimilating learning style. So they use abstract conceptualisation as an approach to knowledge transfer, and reflective observation as a process of transferring knowledge before starting the practical applications in the workshop. This gives students the opportunity to read, think, analyse situations and put information in a logical sequence before moving on to its application.

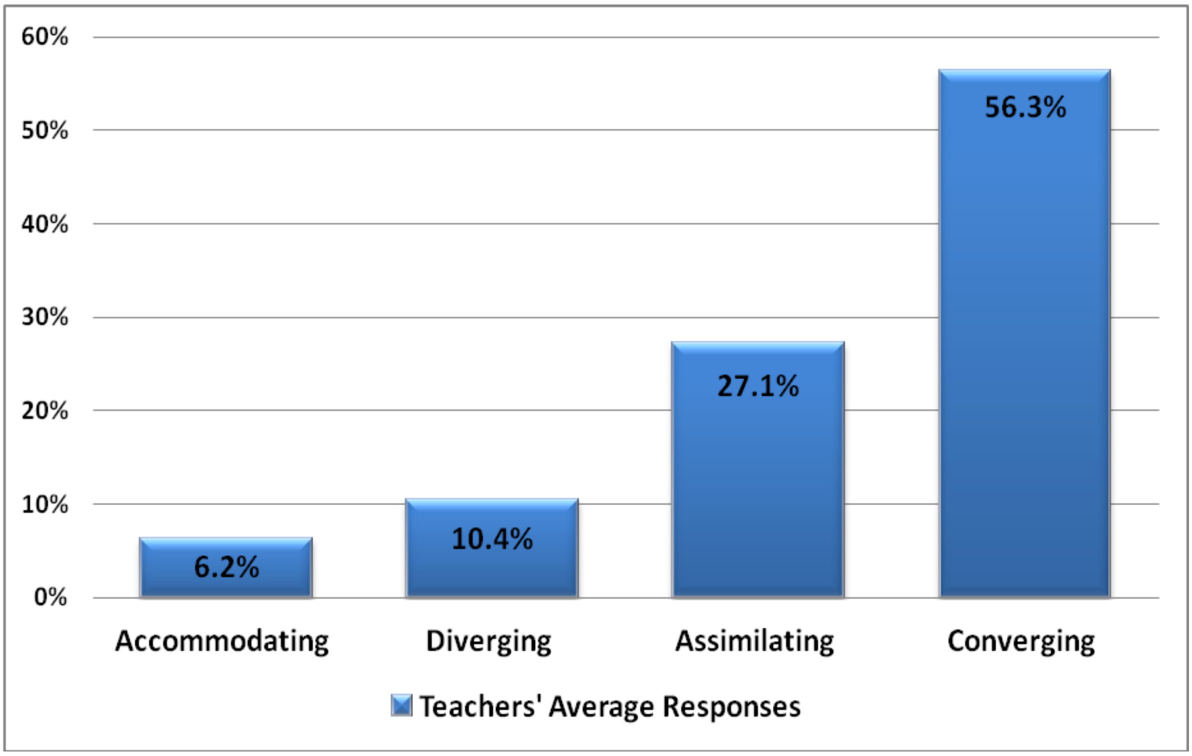

Figure 5.2: The teachers' average responses

The above findings confirmed the conclusions presented by Heywood (2005) that the majority of students from engineering courses have learning styles included in the converging category. Holt and Solomon (2000) showed that the engineering students' converging style helps them to receive instructions and undertake practical studies. These authors also have found that the content of engineering courses was usually developed through practical applications and relied on converging and assimilating learning styles rather than diverging and accommodating ones.

Teachers' answers were also influenced by their personality and preferred teaching styles Stein et al. (2001) have divided teaching styles into four categories:

- **The expert** usually feels that they have to focus on the learning content, give lectures and instructions and provide all the necessary information to students. This teaching style emphasises teacher-centred learning, where students receive the learning content.

- **The provider** tends to place students in guided individual and group learning activities. So this emphasises student-centred learning where students work on projects and should be able to complete certain learning activities with appropriate guidelines.

- **The facilitator** considers the students as independent learners who can work individually and also participate in groups for solving problems. So the students collaborate and are motivated to solve problems in learning activities.

- **The enabler** allows the students to define the learning activities and the process of learning. This teaching style emphasises student-centred learning, where students have much control and more learning responsibilities.

5.2 Questionnaire 2 (User Analysis from Students' Perspectives)

This version of Questionnaire 2 (see Table 5.3) was developed to identify the students' preferences when being involved in the 20 typical learning activities.

Table 5.3: Questionnaire 2 (user analysis from students' perspectives)

No.	Learning activity	***Learning Style A***	***Learning Style B***	***Learning Style C***	***Learning Style D***
1	During the delivery of a new lesson, I like to	Be positively involved ☐	Take my time to listen and observe ☐	Follow practical instructions ☐	Be practical ☐
2	When operating new machine for the first time in the workshop, I prefer to	Concentrate to new experience ☐	Look at all side of required work issues ☐	Analyse concepts and situations ☐	Try things out ☐
3	I learn better when I	Study with my colleague ☐	Write my own notes ☐	Use my imagination and examples ☐	Do simulation work ☐
4	I do not like the theory lessons to be	Group discussion learning style ☐	Questions and answers ☐	Self-study ☐	on-line learning style ☐
5	I like the learning materials to include	Videos ☐	Pictures ☐	Animations ☐	Experiments ☐
6	During the learning process, I do not tend to	Learn independently and immediately ☐	Reflect on my observations ☐	observe results and think of new ideas ☐	reflect my experience in my practical work ☐
7	I prefer the teacher who uses	Groups discussions style ☐	Guest speakers ☐	Examples ☐	Questions and answers style ☐
8	I do not prefer the learning materials which contain	Problem solving activities ☐	Group activities ☐	Pictures and videos ☐	Practical sessions ☐
9	I am the kind of person who	Rely on my experience ☐	Rely on my observations ☐	Rely on my ideas ☐	Do things out by myself ☐
10	When I am explaining something to someone, I prefer to	Give some examples from my experience ☐	Answer questions ☐	Be logical ☐	Work practically and get it done ☐
11	I usually learn faster from	Following instructions and written notes ☐	Listening and asking questions ☐	Giving ideas and examples ☐	Doing assignments and practical applications ☐
12	I do not like to be	Active in group work ☐	Observe and watch situation ☐	Produce ideas and theories ☐	Able to see and touch objects ☐
13	When the teacher is introducing a new situation to me	I accept the new situation as it is ☐	I am aware of what is going on around this situation ☐	I do a study around the situation ☐	I evaluate the situation ☐

No.	Learning activity	*Learning Style A*	*Learning Style B*	*Learning Style C*	*Learning Style D*
14	During a practical session in the workshop, I do not prefer a teacher to	Explain the practical instructions ☐	Show me how to do it ☐	Let me think on how to do it ☐	Let me try it out ☐
15	During a class discussion, I tend to	Participate and explain things out ☐	Be quiet and reserved ☐	Be active and excited ☐	Take responsibilities about things ☐
16	I tend to say that	I like using my experience ☐	I like watching things ☐	I think about new idea ☐	I like doing tasks ☐
17	I do not like the learning environment in the class to be	With my colleague ☐	In large groups ☐	Individual learning style ☐	In small groups ☐
18	I like the teacher who	Divides the class into working groups ☐	Explains things out ☐	Answers questions ☐	Asks students to do the work ☐
19	When I am learning a new skill, I prefer to	Refer to my experience in practicing it ☐	Watch what the teacher is doing ☐	Think on how to do it ☐	Try to do it ☐
20	I usually prefer the learning environment to be	Large classroom ☐	Groups ☐	Small classroom ☐	Workshop ☐

Table 5.4 shows a sample where learning activities are included in rows and the columns contain four learning styles which included in Kolb's learning styles inventory (1984). This sample refers to students' preference when students learn new skills:

A. Refer to experience and practise it (Accommodating).

B. Watch what the teacher is doing (Diverging).

C. Think of how to do things (Assimilating).

D. Try to do it (Converging).

Table 5.4: Sample Questionnaire 2 (user analysis from students' perspectives)

No.	Learning activities	*A (Accommodating)*	*B (Diverging)*	*C (Assimilating)*	*D (Converging)*
1	When I am learning a new skill, I prefer to	Refer to experience and practise it ☐	Watch what the teacher is doing ☐	Think of how to do things ☐	Try to do it ☐

The students were asked to rank their preferences based on a 4-scale:
Grade 1 - Most preferred mode of delivery
Grade 2 - Good mode of delivery
Grade 3 - Adequate mode of delivery
Grade 4 – Least preferred mode of delivery

Tatarkowski and Duckett (2011) showed the importance of determining students' preferred learning styles:

- It helps in planning learning activities for individual and group learning.
- It identifies students' individual needs.
- It increases students' involvement in the process of learning.
- It can shift from a teacher-centred learning to a student-centred learning environment.

Figure 5.3 shows the distribution of the average values for students' responses, each learning activity has a colour code and the *x* axis represents the four learning styles. The respondents ranked each learning activity with regard to the four learning styles, and the average percentage for each possible mode of delivery in every activity is represented along the *y* axis.

For example the distribution of students' most preferred learning approaches (grade 1) for Learning Activity 1 (when they have to do something new):

- 18 students (30%) preferred the converging learning style, involving practical learning activities.
- 16 students (26.7%) of the respondents preferred to read and develop new experience and improve theoretical knowledge – corresponding to assimilating learning style.
- 14 students (23.3%) preferred listening to the teacher's explanation (diverging).
- 12 students (20%) preferred to work practically with in groups with other students (accommodating).

Baldwin and Sabry (2010) mentioned that a possible explanation for the diversity of students' learning preferences could be due to different prior knowledge, cultural and social backgrounds, and behaviour so some may require more assistance and motivation than others.

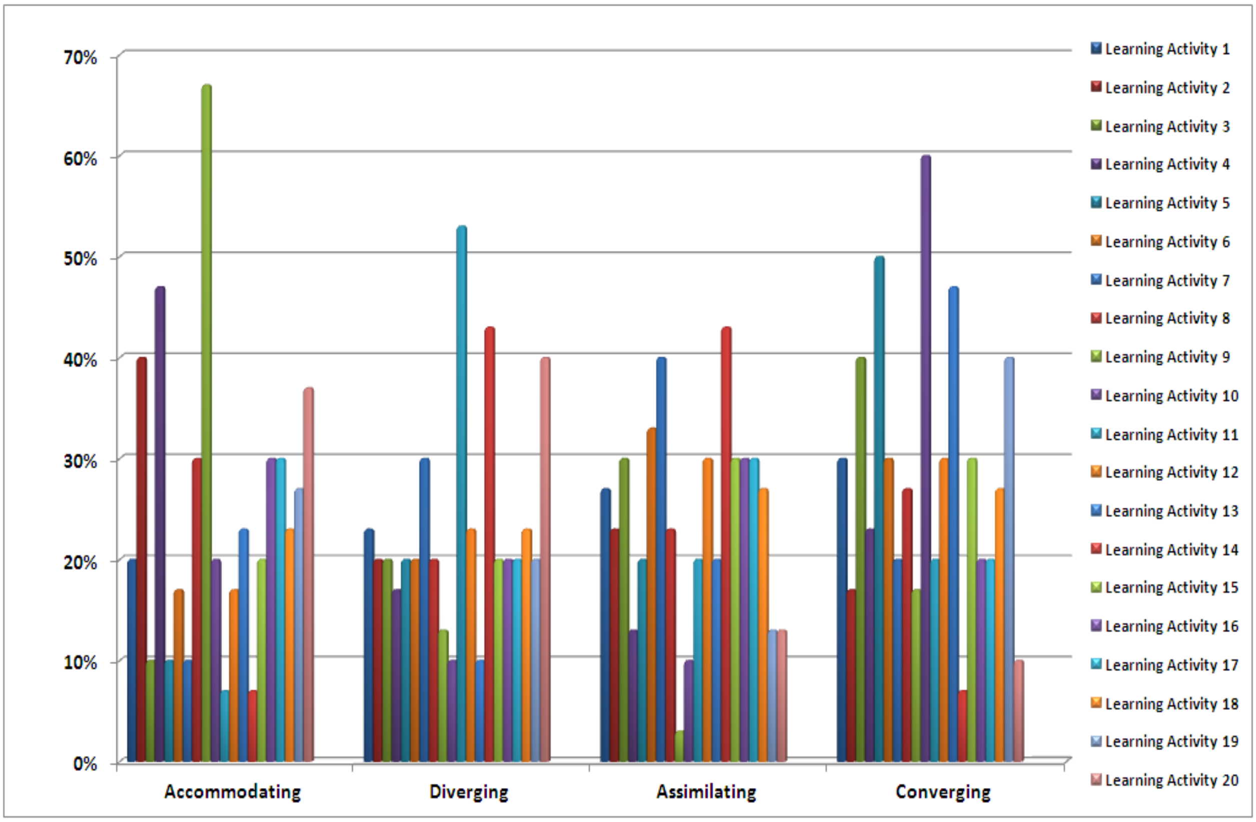

Figure 5.3: Distribution of students' most preferred learning approaches (grade 1)

Figure 5.4 shows the average values for students' most preferred learning approaches along the *y* axis, and the *x* axis shows the four learning styles. A number of 17 students (28.3%) of preferred the converging style, 16 students (26.7%) the accommodating style, 14 students (23.3%) the assimilating style, and 13 students (21.7%) the diverging learning style.

There is an obvious difference between teachers' approaches and students' preferred learning approaches so there is a mismatch between students' learning preferences and TVE mechanisms of delivery. So it is necessary to increase the quality of teaching and learning processes so the different individual needs of a heterogeneous student cohort are considered more.

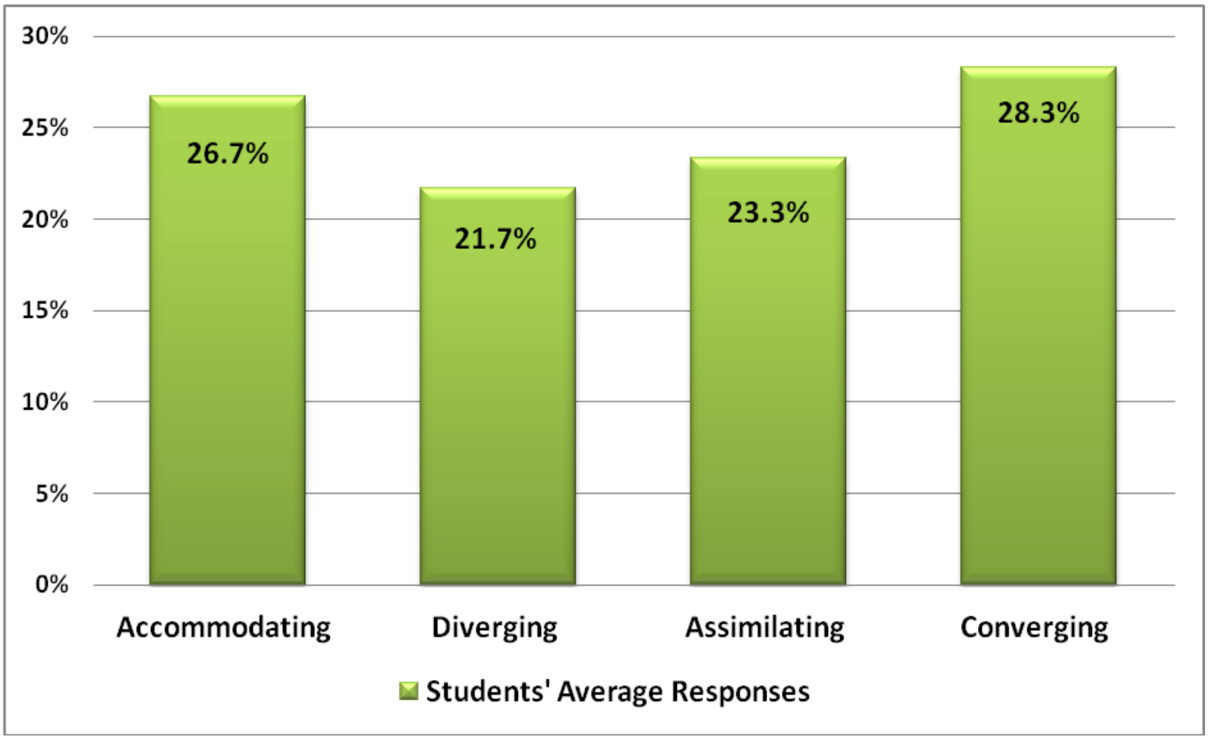

Figure 5.4: The students' average responses

The variation in learning styles preferred by TVE students may be due to several variables, including their behaviour, skills and prior experience. In this sense, TVE teachers must identify and propose ways of teaching that are appropriate for all students.

To overcome any mismatch between the teachers' preferred learning styles and students' individual needs, Sharp (1998) suggested that teachers should have the authority to modify existing learning activities to accommodate various teaching styles. Hein and Budny (1999) added that scheduled workshops and seminars should be available for teachers to share experience and design suitable learning activities for students.

Therefore, the results of Questionnaire 2 should be taken into consideration in designing the learning activities for the proposed SWT module. The module should be flexible and open-ended for on-going modifications and improvements.

5.3 Different Mechanism to Design Modes of Delivery to Suit Various Learning Styles in the Case of the Proposed SWT Module

The analysis for Questionnaire 2 aimed to find out the correlation between the existing approaches of learning practised in TVE educational environment and students' learning styles. Their answers showed that better learning activities with more suitable modes of delivery should be included in EECs in order to suit different learning styles. This section contains examples of various modes of delivery which could be used in the learning activities of the proposed SWT module and the emphasis is on using information technology in the delivery of these learning activities.

McFeely (2002) assessed the link between learning styles and preferred mode of delivery in web-based, classroom and blended-learning environments. The classroom training was not preferred by any Divergers and the web-based approach was not liked by any Accommodators. The regression analysis indicated that Assimilators preferred the blended approach six times more than Divergers. So it is necessary to include a variety of learning activities and modes of delivery in order to satisfy the various learning styles for students.

- Learning Style 1- The Diverger

Svinicki and Dixon (2010) mentioned that the learners with diverging learning style prefer to think about things through concentrating on experience and processing it through reflective observation. These learners prefer to review existing circumstances; listen openly to others' opinions (including those of teachers, guest speakers and other students); and generate new ideas. In this learning style, students also prefer building knowledge and adding new ideas rather than acting or practical applications. So they score highly on Concrete Experience and Reflective Observation (Kolb, 1984).

Table 5.5 presents details of possible modes of delivery for the learning activities which could be more suitable to this learning style. The examples are related to classroom and online teaching, which contain lectures, brainstorming, discussions (face-to-face and online), group learning examples, short-answer exercises, multiple-choice questions, reflective statements, videos and animations, and learning examples. The table also shows the purpose for use and specific learning environment for each mode of delivery.

Table 5.5: Examples of modes of delivery more suited for Diverger learning style

Mode of delivery	Purpose for use	Type of learning environment
Lectures	The teacher presents different information to improve the level of students’ knowledge and understanding	Classroom and multimedia laboratory
Brainstorming	The teacher introduces brainstorming sessions. Students should find new ideas	Multimedia laboratory
Face-to-face and online discussion	The teacher allows students to start discussions. They should share experience and exchange ideas	Classroom and multimedia laboratory
Group learning examples	Teacher facilitates the learning activities and asks students to complete various examples in groups	Classroom and multimedia laboratory
Short-answer exercises	The teacher allows students to answer some exercises	Classroom and multimedia laboratory
Online multiple-choice questions	It is facilitated by the teacher. Students are asked to complete different questions individually	Multimedia laboratory
Reflective statements	Students express their feelings and reflect on their learning experiences	Multimedia laboratory
Animations and Videos	The teacher shows videos Then discussion may take place	Multimedia laboratory
Learning examples	The teacher provides different learning examples for clarification	Classroom and multimedia laboratory at TVE school

- Learning Style 2- The Assimilator

Students with this learning style have a preference for approaching knowledge acquisition through abstract conceptualisation and completing tasks through reflective observation (Richmond and Cummings, 2005). They score highly on Concrete Experience and Active Experimentation.

The assimilators prefer to read materials (such as online content, books, manuals, catalogues), lectures, Internet searches, brainstorming activities, and online practical work guidelines. They prefer to analyse situations, arrange ideas and information into a logical sequence, and create innovative ideas (see Table 5.6).

Table 5.6: Examples of modes of delivery more suited for Assimilator learning style

Mode of delivery	Purpose for use	Type of learning environment
Materials (books, manuals) for reading	The teacher allows students to read, analyse information and think of solutions	Classroom and multimedia laboratory
Lectures	Students analyse information from lectures and create new ideas	Classroom and multimedia laboratory
E-learning content	Students are allowed to read, analyse information and think of solutions	Multimedia laboratory
Search on the Internet	It is facilitated by the teacher to give the students the opportunity to find innovative ideas and solutions individually for different learning activities	Multimedia laboratory
Face-to-face and online discussion	The teacher allows students to start discussions. They should share experience and exchange ideas	Classroom and multimedia laboratory
Brainstorming	Students find new ideas and solutions	Multimedia laboratory
Online practical work guidelines	The teacher shows videos on practical work guidelines. students analyse instructions before practical work is taken place	Multimedia laboratory
Short-answer exercises	The teacher allows students to answer some exercises	Classroom and multimedia laboratory
Online multiple-choice questions	It is facilitated by the teacher. Students are asked to complete different questions individually	Multimedia laboratory

- Learning Style 3- The Converger

Students with this learning style have a preference for hands-on practical applications, simulations, laboratory work, and new experiments with innovative ideas. These students prefer to find practical solutions to problems, decision making, and improving individual knowledge, rather than group work activities. They score highly on Abstract Conceptualization and Active Experimentation (Kolb, 1984).

Table 5.7 presents details of possible modes of delivery for the learning activities which could be more suitable to this learning style: problem-solving activities, field work, real-life examples, practical work implementations, and testing and analysing practical work.

Table 5.7: Examples of modes of delivery more suited for Converger learning style

Mode of delivery	Purpose for use	Type of learning environment
Real life examples	Students are asked to complete practical learning activities based on real life case studies	Practical workshop
Problem-based learning	Students carry out practical learning activities related to solve problems and make decisions	Practical workshop
Technical tasks	Students work in different practical learning activities individually. They are supervised by the teachers	Practical workshop
Videos	Students follow the practical work guidelines presented in videos	Multimedia laboratory and Practical workshop
Animations	Students use the information presented in animations to implement practical learning activities	Multimedia laboratory and Practical workshop
Pictures	Students use the information presented in pictures to implement practical learning activities	Multimedia laboratory and Practical workshop
E-learning content	Students use the information presented in the e-learning content to implement practical learning activities	Multimedia laboratory and Practical workshop

- Learning Style 4- The Accommodator

The students with this learning style prefer to approach knowledge acquisition through concrete experience and perform actions through experimentation. So they feel quite comfortable to participate in learning activities involving group work. These students prefer to cooperate with each other in discussion, solve problems, and provide appropriate solutions. They like the group activities and they may rely on each other in exchanging information, working in teams, and respecting different points of view and ideas. They score highly on Concrete Experience and Active Experimentation (Kolb, 1984).

Table 5.8 presents details of possible modes of delivery for the learning activities which could be more suitable to this learning style such as working in groups, solving problems, relying on others' information, setting plans and goals for challenging new experiences, and learning from other peoples' technical work.

Table 5.8: Examples of modes of delivery more suited for Accommodator learning style

Mode of delivery	Purpose for use	Type of learning environment
Dialogue with other students	Students discuss information in groups, share experience and exchange ideas to implement practical learning activities	Practical workshop
Reflective statements	Students express their feelings and reflect on their learning experiences from various learning activities	Multimedia laboratory
E-learning content	Students discuss and analyse information available online and implement practical learning activities in groups	Multimedia laboratory and Practical workshop
Group practical work	Students work in different practical learning activities in groups. They are supervised by the teachers. They share ideas, feedback, and work collaboratively	Practical workshop
Online practical work guidelines	The teachers show the students videos on work instructions Then students analyse situation and implement the practical learning activities	Multimedia laboratory and Practical workshop
Videos	Students follow the practical work guidelines presented in videos	Multimedia laboratory and Practical workshop
Animations	Students use the information presented in animations to implement practical learning activities	Multimedia laboratory and Practical workshop
Pictures	Students use the information presented in pictures to implement practical learning activities	Multimedia laboratory and Practical workshop
Face-to-face and online discussions	The students discuss different learning activities and share experiences in groups	Multimedia laboratory and Practical workshop

Chen and Macredie (2002) and Evans et al. (2002) explained that information technology gives students an opportunity to become more flexible in their learning process, expand their interaction beyond traditional teaching and learning, access learning materials online and spend more time interacting with other students in online discussions. In addition, using information technology in the delivery of learning may suit individuals' behaviour, as they may be more comfortable with the system and can understand the learning activities in their preferred way of delivery. In short, the technology solution provides a better learning environment to satisfy the students' various learning needs.

Therefore modes of delivery using information technology for SWT learning activities have been included in Tables 5.5 – 5.8.

Kanninen (2008) stated that students with a certain learning style prefer specific e-learning activities as follows:

- Accommodators need interaction with other students in e-learning environment, therefore group works and online discussions are most suitable for them.

- Divergers prefer e-learning materials and online discussion forums and boards because they like outlined information from lectures and direct instructions from the teachers.
- Assimilators favour traditional learning activities which are systematic and logical (such as online multiple choice quizzes).
- Convergers prefer practical learning activities and exercises; therefore, they tend to use online discussion boards and learning materials to solve practical issues.

Manochehr (2006) concluded that the students with assimilating and converging learning styles learn more and obtain better results if technology is integrated in the learning activities. The study also mentioned that the students with diverging and accommodating learning styles prefer to receive also teachers' explanations and supervision.

Figure 5.5 shows a case study of a learning activity included in the proposed SWT module. The example has several modes of delivery used in two learning environments (multimedia laboratory, practical workshop):

- **Lectures** – the teaching material is presented by the teacher in the learning environment. So the students receive information through direct instructions and could read online learning materials (preferred more by the students with diverging learning style).
- **Online learning materials** – the technology allowed students to analyse information at their own pace, motivate themselves better, participate in online discussions and get an initial insight into real-work applications (diverging and assimilating learning styles).
- **Face-to-face and online discussion** - students have the opportunity to discuss the learning activities either in face-to-face discussions and online discussions. This mode of delivery allows students to think and become more creative in problem solving learning activities (preferred more by the students with diverging and assimilating learning styles).
- **Practical work guidelines** – which are presented online as a video recording about the operation of the machines and equipment from workplace. Teacher also provides some explanations and clarifications while students are watching the video (preferred more by the students with diverging learning style). Then, the students are allowed to spend some time individually to watch the video again and are asked to prepare a strategy for carrying out practical learning activities (preferred more by the students with assimilating learning style).
- **Technical tasks** - students can work in practical learning activities individually and are supervised by the teachers, to convert the theoretical information and the work instructions

into practice. Students also can work in groups supervised by the teachers so the students are sharing ideas, provide feedback and work collaboratively. These practical learning activities allow the students to work individually (preferred more by the students with converging learning style) or in groups (preferred more by the students with accommodating learning style).

- **Reflective statements** – where the students express their feelings, reflect on their learning experiences, identify their strengths and areas for improvement (preferred more by students with diverging and accommodating learning styles).

This case study showed several modes of delivery which could be included in one learning activity so students with various learning styles have access to the teaching material in diverse ways and are able to reflect on their strengths and weaknesses.

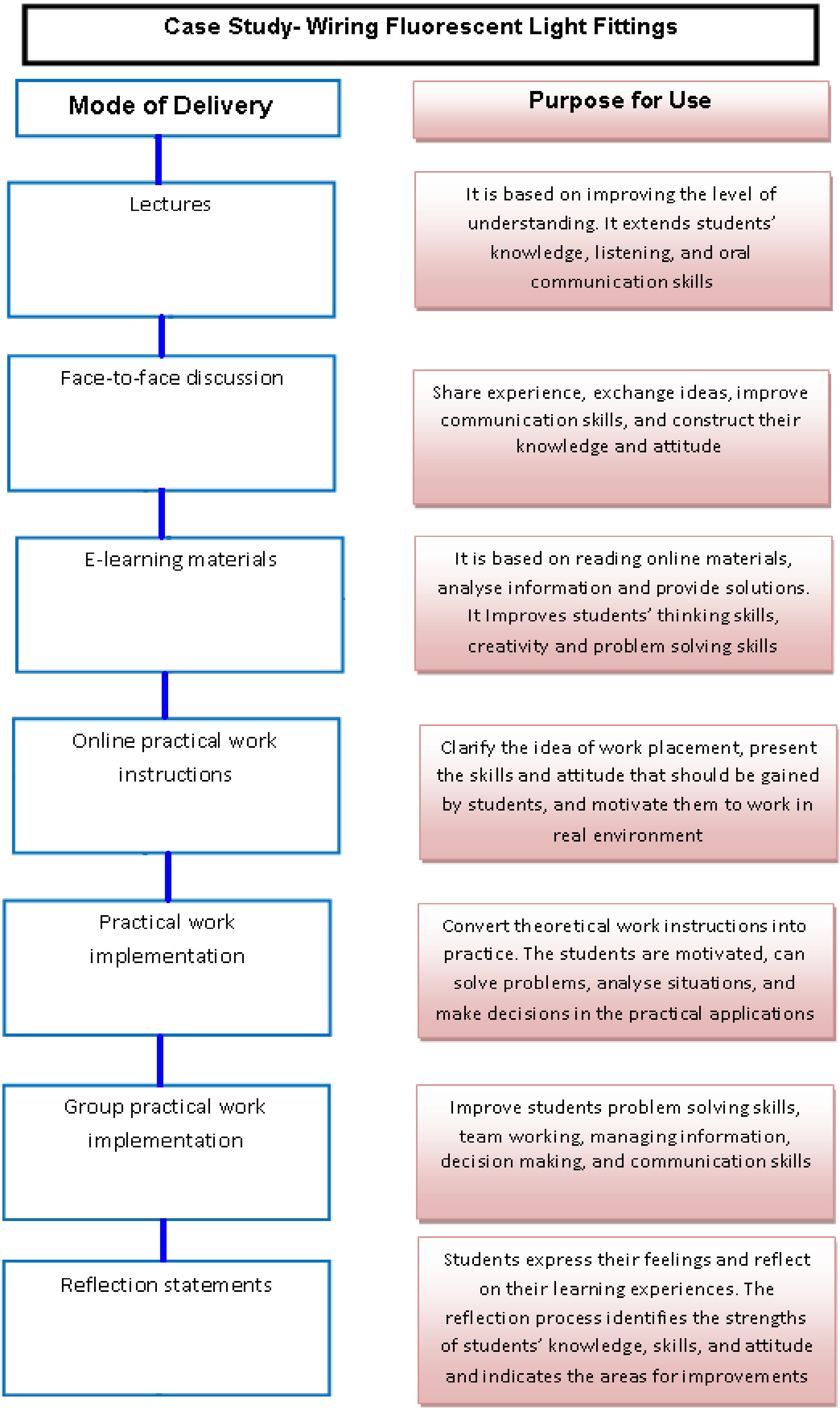

Figure 5.5: A case study of a learning activity included in the proposed SWT module

5.4 Summary

This chapter analysed the responses to Questionnaire 2 provided by 48 teachers and a pilot group of 60 students in Year 2. The questions were formulated based on Kolb's Learning Style Inventory (LSI) and aimed to find out the teachers' and students' opinions about the existing EECs.

The purpose was to examine the correlation between the existing approaches of teaching and learning practised in TVE educational environment with students' learning styles. The teachers' and students' responses showed that more diversified learning activities should be included in EECs in order to suit different learning styles.

The final section of this chapter contained examples of various modes of delivery which could be used in the learning activities of the proposed SWT module. The emphasis was on using information technology (i.e. diagrams, charts, videos, animations, hyperlinks) in the delivery of these learning activities which would enable students to prepare better for the work placement and industrial environment.

The researcher has published the following papers which are related to this chapter content:

- A diagnostic study on the teaching and learning styles in engineering education courses, School of Computing and Engineering Researchers' Conference, University of Huddersfield, December 2010.

- Improving Teaching and Learning Effectiveness in Engineering Education, the International Journal of Learning, volume 17 in 2011.

The next chapter presents the design and development of the proposed SWT module. The module is intended to develop TVE students' employability skills during SBL and receive the necessary training required by industry before they go in a WBL programme.

CHAPTER 6 - The Proposed SBL-to-WBL Transition (SWT) Module

This chapter presents the design and development of the proposed SWT module. The responses from teachers, HR specialists, and industrial supervisors to Questionnaire 1 have shown that there is a gap between the skills developed during SBL and WBL programmes and industry requirements.

The main aim of this proposed module is to ensure that TVE students receive the necessary training required by industry before they go in work placement (included in WBL programme).

The structure of Year 3 for the TVE system is as follows:

Semester 1 contains 15 weeks of teaching (SBL)

Semester 2 has 9 weeks of teaching (SBL) and 6 weeks of work placement (WBL).

The proposed SWT module is intended to be delivered in Year 3 (Semester 1) prior to the period when students go to work placement.

Currently, the TVE students attend one day per week for the practical sessions presented by teachers in the Institute workshop. Also they attend one day induction seminar presenting the work environment from industry.

The first part of this chapter presents the stages of the design for e-learning package incorporated in the proposed SWT module: user analysis; structure and representation; knowledge and communication analysis; interface and navigation design. The teachers from TVE system performed the expert evaluation of the e-learning package (prototype) and the details are presented in Chapter 7. Then the researcher amended the prototype in accordance with the experts' comments.

The second part of the chapter explains the five case studies which have been included in the proposed SWT module. The design of learning activities and modes of delivery took into consideration the teaching and learning styles and the development of students' cognitive, affective and psychomotor skills. The proposed SWT module has been introduced in the TVE curriculum in the academic year 2010-2011 and the TVE teachers and students performed the user evaluation of the revised prototype (see Chapter 7).

6.1 Design of the E-learning Package of the Proposed SWT Module

The proposed curriculum content of the SWT module was converted into five case studies which have been implemented into an e-learning package (prototype). Figure 6.1 shows the process of converting the physical learning content into e-learning content.

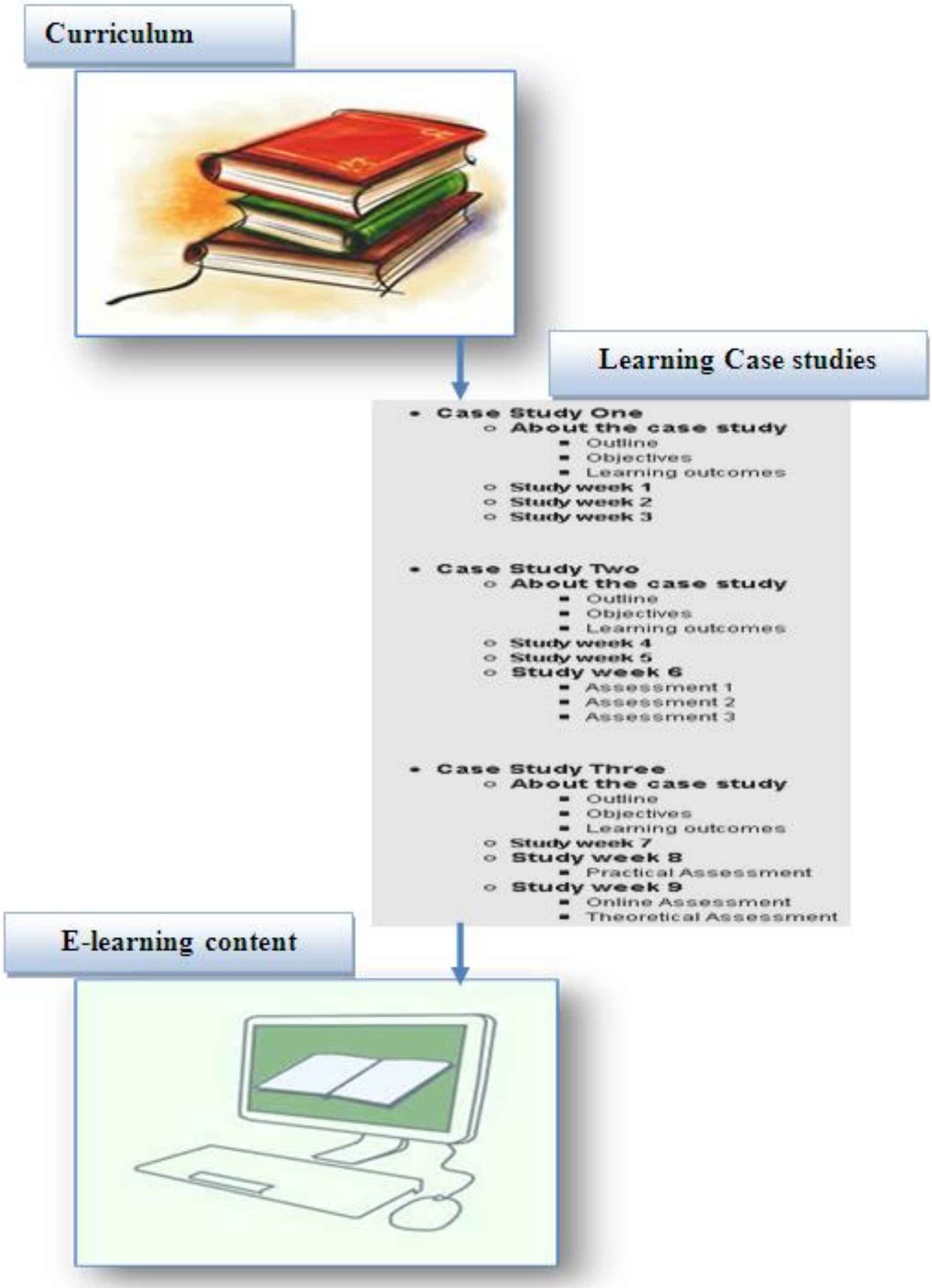

Figure 6.1: The process of converting the proposed SWT module to e-learning package

The design of e-learning package refers to the following aspects: user analysis; structure and representation; knowledge and communication analysis; interface and navigation design. The user analysis concentrates on the TVE stakeholders, institutional, pedagogical and technological contexts. The structure should be based on theoretical underpinnings related to learning environment and learners. The content of e-learning package is developed on the technical knowledge related to the workplace and communication theories. The use of videos, animations and simulations represent an experiential approach to learning which allows the students to engage in the construction of knowledge based on their own experiences.

6.1.1 User Analysis

Hussein (2005) underlined that the user-centred design of e-learning packages should consider the profiles of stakeholders, institutional, pedagogical and technological contexts of products implementation. The stakeholders of the designed e-learning package are the employers, teachers and students. The correlation between the existing approaches of teaching and learning practised in TVE educational environment with students' learning styles was examined using Questionnaire 2 (see Chapter 5).

Stakeholders

Employers- this category refers to industrial supervisors who manage the TVE students during work placement in Year 3 and HR specialists who accept students for work placement. The employers participated in Questionnaire 1 (see Chapter 3). They represented 20 industrial companies which have previously received TVE students. These people were expected to work with the groups of TVE students after the proposed SWT module was included in the curriculum.

TVE teachers- deliver EEE modules and supervise practical sessions in the Institute workshops. Two teachers from Sheikh Khalifa Institute have provided direct instructions and supervised online theoretical learning activities (within classroom and multimedia laboratory). Other three teachers have supervised the practical learning activities (within the Institute workshops). Also these teachers contact the industrial companies and organise work placements for TVE students. They meet regularly with industrial supervisors to observe training programmes and ensure students' progress.

TVE students- are enrolled into TVE institutions at age 15 based on their preferences and learning capabilities. In his role as a TVE teacher, the researcher observed that students in Year 1 had diverse knowledge, skills and backgrounds so the TVE institutions should create an environment where everyone is treated fairly regardless of ethnic origin, religion or belief, age or nationality.

Institutional context

Strategy and policy - the TVE system intends to equip the students with the skills, knowledge and work ethic required for various engineering companies. These can be obtained through a two-tier system education (SBL and WBL). SBL contains general and specialised modules presented in the school environment and WBL gives the students access to industrial environment which enable the development of the practical skills and prepare them for employment after graduation. Currently the SBL and WBL are not strongly connected so it is necessary to change the strategy and policy of TVE system. Students have only one day per week for practical learning activities and the remaining four days are allocated for theoretical learning modules. Therefore, a new strategy should be placed for effective use of SBL to prepare students before they go to the workplace.

Tracks and programmes - TVE institutions provide various engineering specialisations divided in two routes: Secondary Technical Certificate route (for students with excellent academic abilities demonstrated in Year 1 and 2) and Secondary Vocational Certificate route (for students with good practical skills) (TVE Directory, 2008).

Qualification offered - students who obtain a secondary technical route certificate may study at universities, polytechnics and also may join the labour market. Students who obtain a secondary vocational route certificate could join directly the labour market or choose to study in polytechnics (EDB and TVE, 2007).

Innovative pedagogical approaches - It was suggested to improve the pedagogical approaches by introducing integrated learning environment for the delivery of modules by focusing on student-centered learning.

Forms and assessments - the theoretical modules from Years 1, 2 and 3 have two written exams per semester. The practical modules have a competency-based assessment at the end of practical experiments.

Cross-institutional accreditation - all TVE courses and programmes are approved by the Ministry of Education in Bahrain. All programmes are quality assured by the Bahrain Quality Assurance Authority in each academic year. Reports are issued with courses strengths and point for future development (QAAET, 2010).

Institutional collaboration - TVE teachers are involved in staff development programmes during the academic year. Also, teachers are rotated among TVE institutions in order to share experience with others.

Pedagogical context

Biggs (1999) defined pedagogy in three themes of learning: planning the learning outcomes, defining the learning theories (for curriculum development, teaching and learning processes, and assessment strategy), and then studying the usability of the learning resources. Pedagogical context should ensure that design of learning outcomes, activities, environments; teaching and learning processes and assessment methods are effectively linked together.

This research presented four complementary models which have been used in the design of e-learning package and the development of the proposed SWT module:

a) Employability skills training model (see Chapter 3).

b) 2D models for cognitive, affective and psychomotor skills (see Chapter 4).

QAAET report (2010) confirmed there was a shortfall between the current teaching styles and various students learning needs. Therefore this research presented the analysis of teachers' and students' preferences related to learning activities and propose different mechanism to design modes of delivery to suit the various learning styles in the case of the proposed SWT Module (see Chapter 5).

Cullen et al. (2002) indicated that the pedagogical context in TVE could be characterised to be more learner-centred, work-centred and attributes focused in order to cope with the rapid changes in industrial companies and cope with their modern skills requirements.

Learner centred - Constructivist learning adopted a more learner centred approach which is based on students' constructing new information from previous knowledge and improving thinking skills through the interaction with the learning environment. Also, pedagogical principles (such as Bloom's taxonomy, Kolb's models of learning and collaborative learning theory) should be considered while designing the curriculum content. A recent study by QAAET (2010) examined if the existing pedagogical context of the TVE system and concluded that the existing curriculum is based on teacher-centred learning approach. So it is necessary to move towards student-centred learning approach and achieve better balance between theoretical modules and practical applications.

Work centred - it is essential for the engineering courses to enable the development of relevant employability skills for students. Billett (2008) underlined that the global economy is facing a number of challenges so the industrial companies demand various skills from the employees. Although soft skills (such as reading, writing, problem solving, team working, and communication skills) are still in demand, a new skill set (cognitive, affective, and psychomotor domain skills) is also required to meet current and future market requirements.

Attribute focused- the pedagogical processes that enable the achievement of learning outcomes for TVE modules should consider the development of work-related attributes in students. The QAAET report published in 2010 indicated that only some employability skills required by industry were integrated in either the theoretical or practical learning outcomes of TVE modules. The report recommended focusing on up-to-date employability skills, improving students' work ethics and work-related attributes in SBL and WBL programmes, and awareness and responsibility of their behaviour.

Technological context

The Ministry of Education (MOE) in Bahrain introduced technology in the mid-80s for both general and TVE institutions, starting by providing computer laboratories in schools and delivering teachers' training programmes. Later, learning resource centres were opened in various schools, with personal computers linked to the World Wide Web. In 2005 the MOE established the new institute (Sheikh Khalifa) which is fully equipped with practical laboratories containing up-to-date equipment and software packages for assisting the teaching and learning processes. Currently the software packages are mostly used in core (theoretical) SBL modules such as Mathematics, Science, and English Language. The researcher suggests the increase use of technology in the specialised SBL modules such as including online content for engineering courses, animations for explaining engineering experiments, videos for practical work guidelines, pictures of real work environment, scenarios of engineering problems to be discussed online.

6.1.2 Structure and Representation

Tomei (2008) identified that e-learning prototype should contain a learning management system (LMS) with web portals as components to manage, monitor, and maintain electronic data and communication in the prototype. Therefore, the LMS should be structured in a manner to support and represent the learning activities as required. The structure and representations of learning activities and assessments should consider some functionality such as buttons, icons, live hyperlinks, and audio and video clips might be added to have better representation of the prototype as well as meeting users' satisfactions. Pislaru (2008) added that structure and representation allowed the e-learning users to build different referential connections among visual and verbal information prior knowledge. Examples could be animations, interactive tutorials and personal notes options.

Figure 6.2 shows an example from the e-learning package. The information is organised sequentially with details about the module (i.e. outline, learning outcomes, teaching, learning and assessment strategy) followed by details related to case studies.

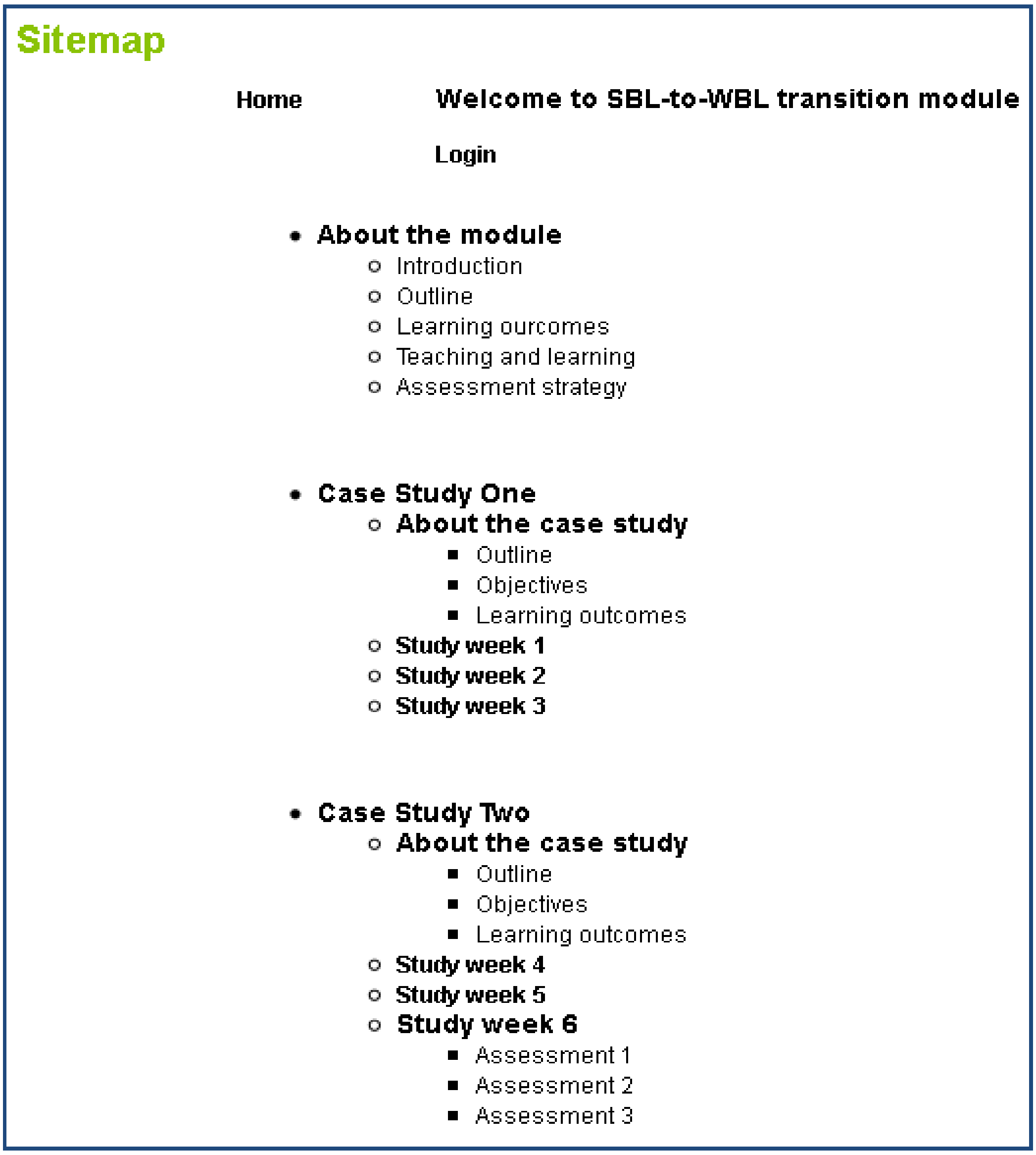

Figure 6.2: An example of a structured template of the e-learning package

Figure 6.3 represents the e-learning package layout which was designed and implemented by an external provider (SDS Softwares) under researcher's guidance and requirements. The main page contained several menus and relevant photos showing the aim of the SWT module (development of students' employability skills in the classroom, multimedia laboratory and Institute workshop). Also the figure shows the menu for case study 3 as an example. The case study was structured sequentially, starting with a general overview and learning activities for every week. The students can move from one part of the menu to another during the teaching weeks which are associated with this case study.

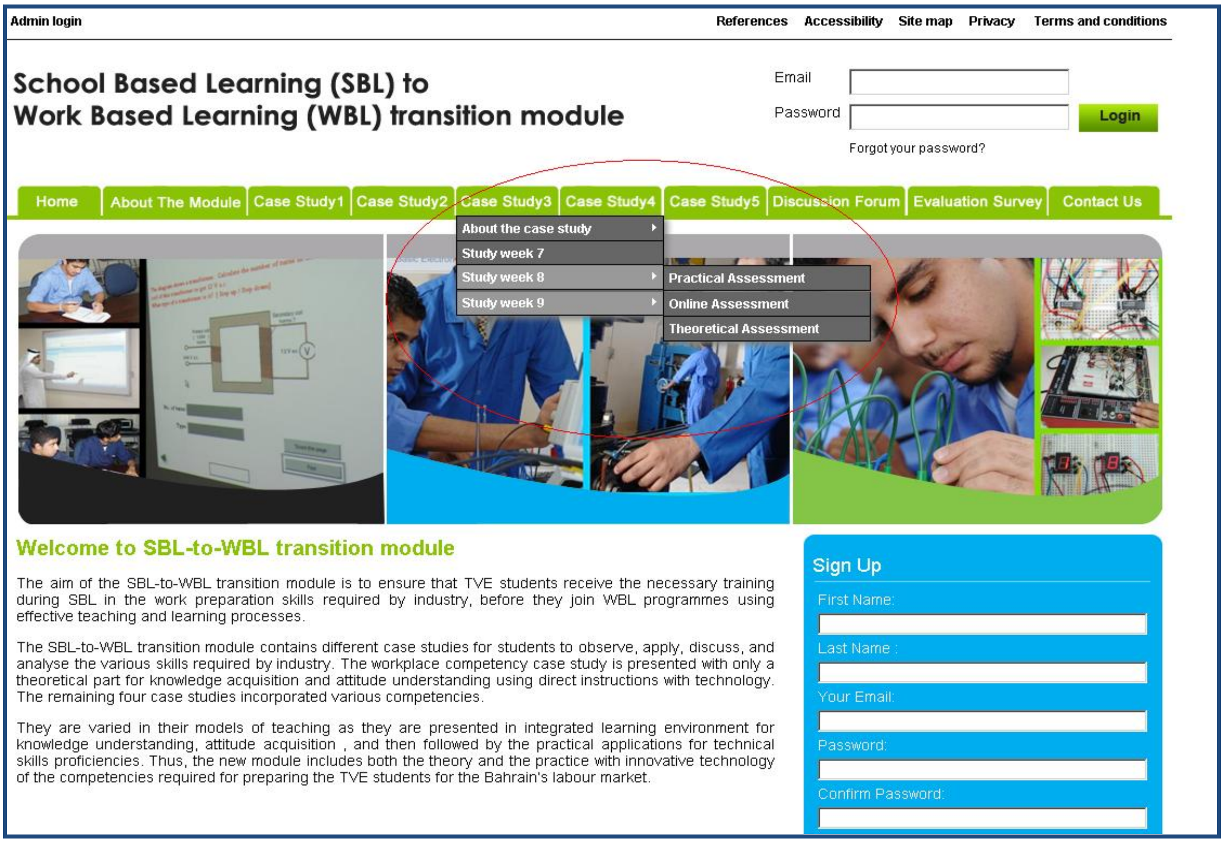

Figure 6.3: The e-learning package representation

6.1.3 Knowledge and Communication Analysis

The e-learning package should contain technical and social perspectives for all users (Tomei, 2008). The prototype design should have reusable communication patterns for sophisticated technical support and create open communication channels. Social networking between students and teachers should be considered as a critical issue in the application of the learning activities delivered through the e-learning package. Figure 6.4 shows two examples of social techniques included in the e-learning package. The group discussion forum allow the students to participate freely online, asking questions and opening new threads related to the learning activities. The discussion board is co-ordinated by the teacher who formulates points to discuss, and each student should participate to every thread of discussion before moving to the next page of the e-learning package.

Sharpe et al (2005) underlined that the students could be active learners while participating in the e-learning package (i.e. using online discussion) therefore they would experience new knowledge and improve their ICT skills, social skills, and emotional intelligence.

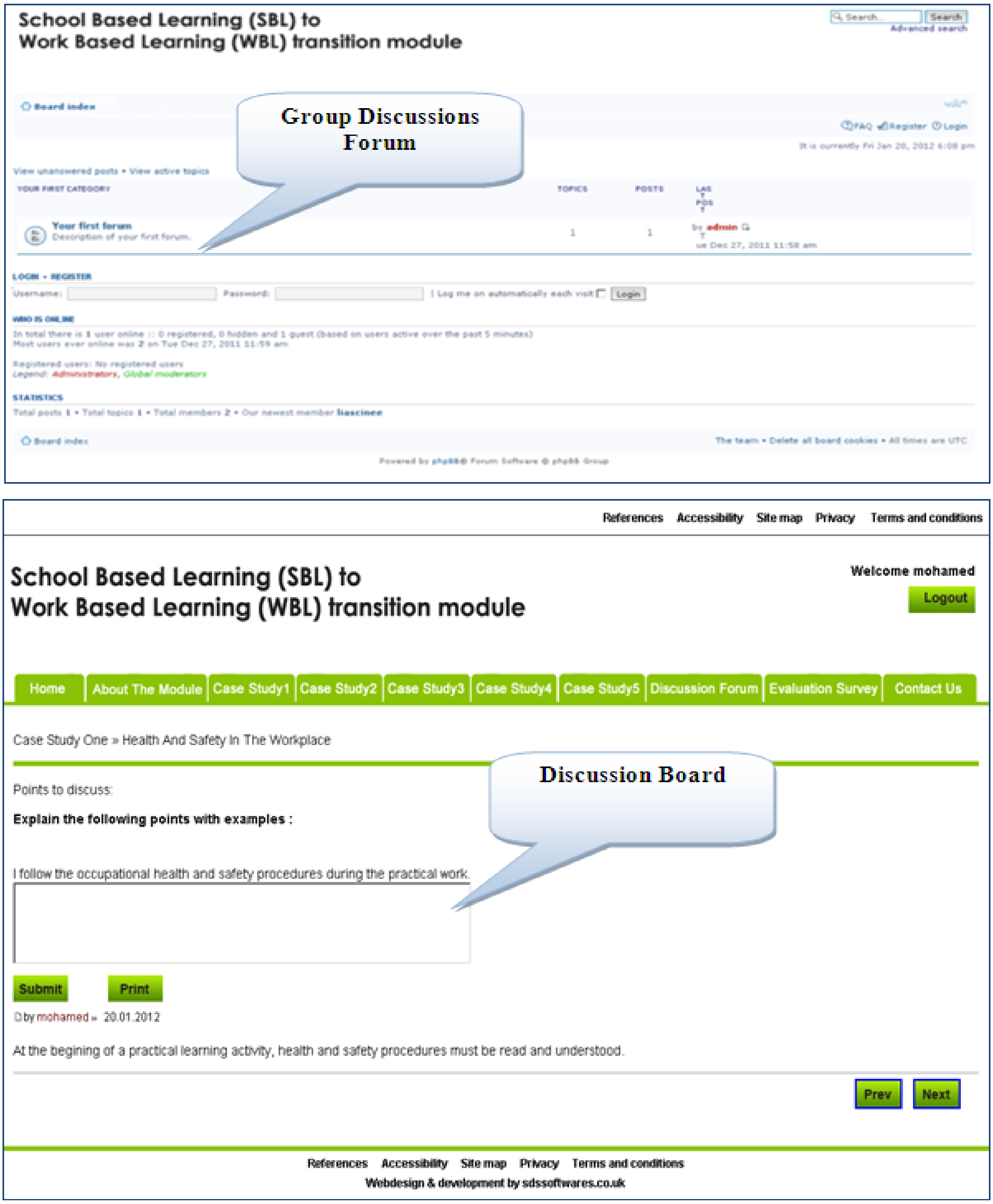

Figure 6.4: An example of knowledge analysis and communication in the e-learning package

6.1.4 Interface and Navigation Design

Various authors emphasised the importance of information analysis and linking and communicating data when designing the navigation within the e-learning prototype. Vavoula and Sharples (2002) underlined that the interface design of the e-learning package should start with a series of screen designs. The interface should be based on *'timelines metaphor'* that was defined as *'graphical representations (lines) that depict a period of time during which a specific event was occurring'*.

After converting the learning materials and assessments to e-learning content, the prototype interface and navigation design were critically checked against some of the usability issues (see Appendix D1), such as package effectiveness and flexibility in Internet browsing, and moving from one activity to another in the e-learning package. The e-learning package contained interactive web pages (including pictures, animations, videos, simulations) and online exercises such as multiple choice questions with instant feedback. Also, the users could easily move from one page to the next using the attached icons in the main menu and buttons in the web pages. So this e-learning package had features appropriate to different learning styles and enabled students to actively engage online with the learning activities.

6.2 The Development of the Proposed SWT Module

The aim of the proposed SWT module is to ensure that TVE students receive the necessary training in SBL, before they go to WBL programmes. The initial module specification is included in *Appendix C1*.

The SWT module has been developed and contained five different case studies. The learning activities allowed the students to analyse practical engineering problems, find relevant solutions and develop cognitive, affective and psychomotor skills required by industry. The case studies were defined after reviewing the existing skills gap between SBL and modern industry requirements. The SWT module is available online on www.sbltowbl.com. It is securely protected so the students have to register online in Semester 1 and receive an approval email with username and password. The teachers are activating the access to each case study as per the teaching plan of the module.

The proposed module is tended to be delivered during Semester 1 (Year 3) for 15 weeks between September – January before students' progression to the WBL programme.

Table 6.1 shows the proposed case studies including their study weeks, titles, aims and objectives.

Table 6.1: The proposed SWT module case studies

Study Week	Case Study	Aim	Objectives
1 **2** **3**	Introduction to Workplace Environment *More details are provided in appendix C2*	Introduce the fundamentals of workplace environment	- Introduce the idea of work placement to TVE students. - Identify the importance of health and safety in the workplace. - Assist students in developing their skills, knowledge, and attitude within a workplace environment. - Cover the important information that students are supposed to possess when placed on the WBL programme.
4 **5** **6**	Study the Elements and Operation of Battery Charger Circuits from Cars *More details are provided in appendix C2*	Employ effective online learning activities for battery charger circuits	- Improve TVE students' ICT skills. - Choose the appropriate components for building the circuit. - Improve students' cognitive skills, including reading, writing and listening. - Develop students' affective skills, including managing information, communication skills, innovation, and decision making. - Encourage students in collecting information about battery specifications from various sources (i.e. Internet)
7 **8** **9**	Design and Development of Electronic Circuits for Car Parking Counter *More details are provided in this chapter*	Develop students' theoretical background and practical applications	- Access online for theoretical information. - Design a car parking counter using logic gates. - Understand the procedure required to assemble car parking counter. - Improve students' affective skills (i.e. ICT skills, managing information, communication skills, problem solving, innovation, decision making, and self-motivation). - Develop students' cognitive skills. - Develop students psychomotor skills.
10 **11** **12**	Design and Implementation of Direct On Line (DOL) Starter Circuits *More details are provided in appendix C2*	Encourage students to work in groups in practical learning activities to improve various employability skills	- Identify various components of a Direct On Line (DOL) starter. - Provide the theoretical background information before students start the practical learning activities. - Display pictures with appropriate explanation regarding practical work implementation. - Divide students into two groups: <u>Group one:</u> Wire up the power circuit of the DOL Starter based on the data collected from the motor to be connected. <u>Group two:</u> Wire up the control circuit of the DOL Starter suitable for the power circuit. - Communicate with each other in carrying out the practical learning activities. - Participate in solving problems and decision making during the practical work. - Carry out troubleshooting of the motor control circuit in groups.
13 **14** **15**	Practical Assembly of Fluorescent Light Fitting *More details are provided in this chapter*	Plan a marketing strategy for industry	- Identify the various components of a fluorescent light fitting. - Select the appropriate components required to wire up a fluorescent light fitting. - Test the fluorescent tube, ballast (choke) and starter. - Wire up the fluorescent light fitting. - Communicate with the team members in carrying out the learning activities. - Solve any problems that may occur during the practical work. - Improve students' thinking skills, initiative, innovation, and decision making competencies. - Carry out troubleshooting of the fluorescent light fitting circuit in groups. - Produce a report reflecting your experience.

The pilot implementation of the SWT module and e-learning package was done between October – November 2010 and case study 3 and case study 5 were presented by the teachers. These two case studies were considered to be relevant because:

- Contain various learning activities enabling the development of students' cognitive, affective and psychomotor skills.
- Provide comprehensive online theoretical information.
- Contain various practical applications which allow the students to use their knowledge for the development of relevant technical skills.
- Focus on student-centred learning through team working and problem solving activities.
- Use technology (animations, simulations, videos) to present the industrial environment.
- Provide discussion boards and forums where students can ask questions and clarify points of view in their own time.
- Provide online practical work guidelines.
- Contain various modes of delivery (teachers' direct instructions, online material) appropriate for various learning styles.
- Comprise practical, online and written assessments.

The other case studies 1, 2, and 4 are presented in *Appendix C2*.

6.2.1 Case Study 3 – Design and Development of Electronic Circuits for Car Parking Counter

The case study should be delivered in three teaching weeks (weeks 7, 8, and 9). The teachers should activate the relevant content before week 7 so the students can access the website (e-learning package) using their approved user names and passwords.

Study week 7 - the teachers present the theoretical background to the students in multimedia laboratory. The webpage contains the outline, objectives and learning outcomes for this case study. Therefore, discussions between students and the teacher may be carried out to identify the learning requirements and goals to be achieved. The students study the online materials (including animations, pictures and videos) related to the working principles of the car parking counter circuits during this laboratory session.

Study week 8 - the students have a practical session in the Institute workshop. Prior to this session the students watch a video included in the webpage showing the stages of the practical laboratory. The teachers give the students printed copies of the practical work guidelines and assessment procedures and questions. After the laboratory session the students must complete the assessment on an individual basis.

Study week 9 - the students are assessed through online assessment (answers are submitted electronically) and theoretical assessment (answers are printed and submitted by hand).

On completion of the case study, the students must be able to:

- Demonstrate in-depth understanding of the skills required during the WBL programme.
- Feel confident in their ability to exercise the learning activities.
- Demonstrate different thinking skills in group discussion activities during interaction with the e-learning package.
- Collect specific information about digital electronic components from various sources such as manuals, catalogues and Internet search engines.
- Identify the terminals and pin configuration of various Integrated Circuits (ICs).
- Wire up a seven-segment decoder with seven-segment display.
- Wire up a two-digit counter using 74LS190 in Count Up and Count Down modes.
- Cascade two binary counters.
- Wire up a presettable counter to count up to a desired number.
- Create the complete car parking counter circuit.

Learning content design - The content provided in this case study aims to enable the development of students' cognitive and affective skills (which have been included in the 2D models presented in Chapter 4). Figure 6.5 shows the cognitive skills learning levels (LC) and the affective skills levels (LA) employed in the content of the learning materials.

The 2D model for cognitive skills considered the learning levels and category of knowledge. The first dimension was represented by the learning levels (LC1-LC3) which were employed in the learning content; the knowledge was also structured for doing something and related to cognitive skills for improving students' abilities in accessing information, listening, reading and writing.

The second dimension of the model was the category of knowledge being learnt which considered in the cognitive skills learning content in terms of:

- Facts: the learning content is based on online and reliable amount of information.

- Concepts: the knowledge is structured on learning theories and has is related to information.
- Procedure: The knowledge is structured into procedures.
- Strategy: The knowledge organises information systematically and specifically.

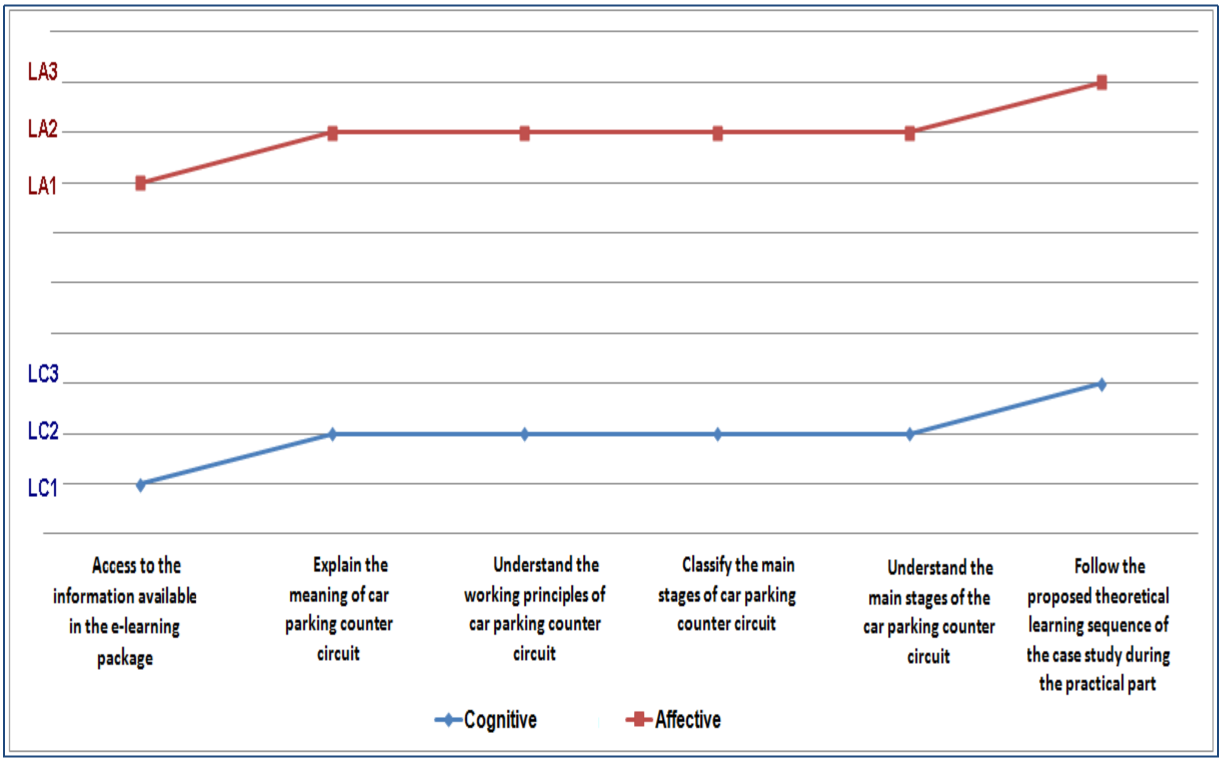

Figure 6.5: The learning levels employed in the content

The 2D model for affective skills considered the learning levels employed in the content and the attitude being developed. The learning content was designed to include the learning levels (LA1-LA3) related to receiving, responding to and valuing the content.

Also the social skills should be developed in parallel with the ability to acknowledge access and find information, participate actively and follow instructions, and negotiate the work procedures with others. This case study should enable the development of communication skills because the students receive information, communicate with others; negotiate solutions within groups and present written materials.

Figure 6.6 shows an example of using animations to display the working principles of a 7 Segment Decoder which was included in the material related to study week 7.

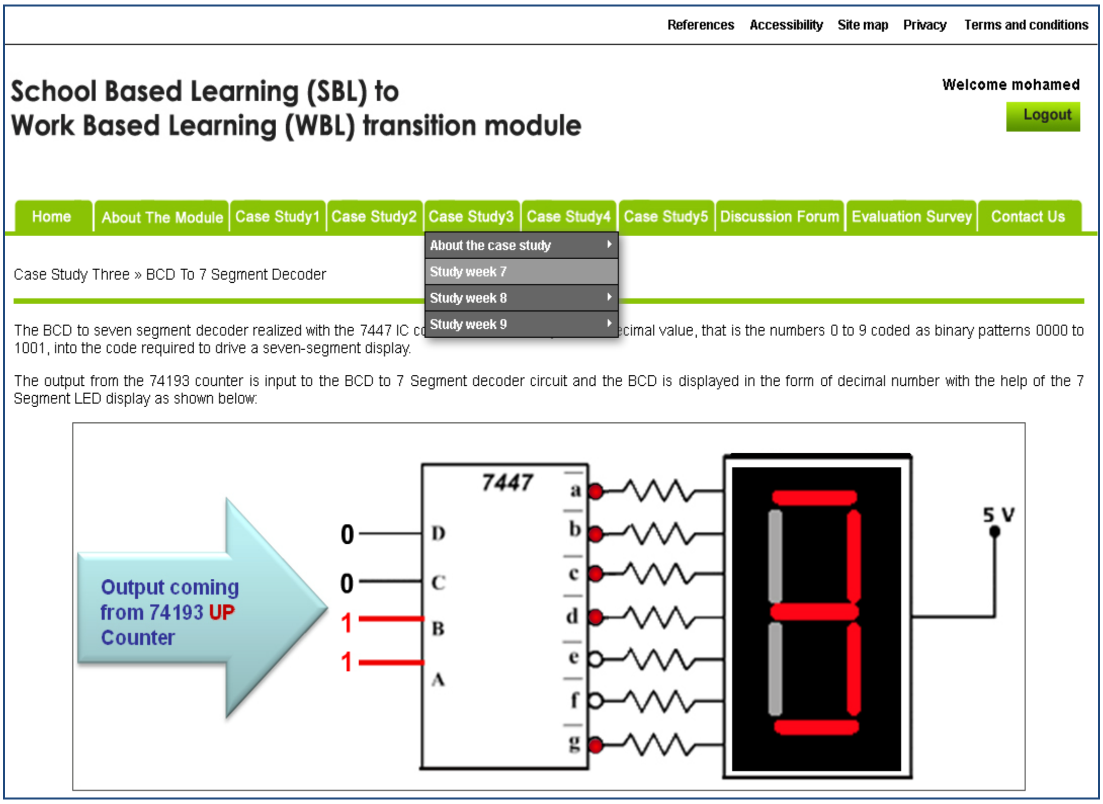

Figure 6.6: An example of using animations

Figure 6.7 shows the practical assessment in study week 8. The students have the opportunity to follow the learning actions: watch the practical work guidelines video, access the practical work file, read instructions, draw the circuit diagram of each stage of the Car Parking counter referring to the individual stages of the given block diagram, prepare a list of the components required along with their specifications, refer the Components Data book available in the practical workshop or Google search for detailed specifications of the components. Then students have to answer the questions related to these elements:

- Seven segment decoder with seven segment display.
- Two Digits counter using 74LS190.
- Cascading Counters.
- Presettable Counters.
- Auxiliary circuits like Zero Detector, Contact Debounce circuit.
- Integrating all the circuits used for car parking counters.

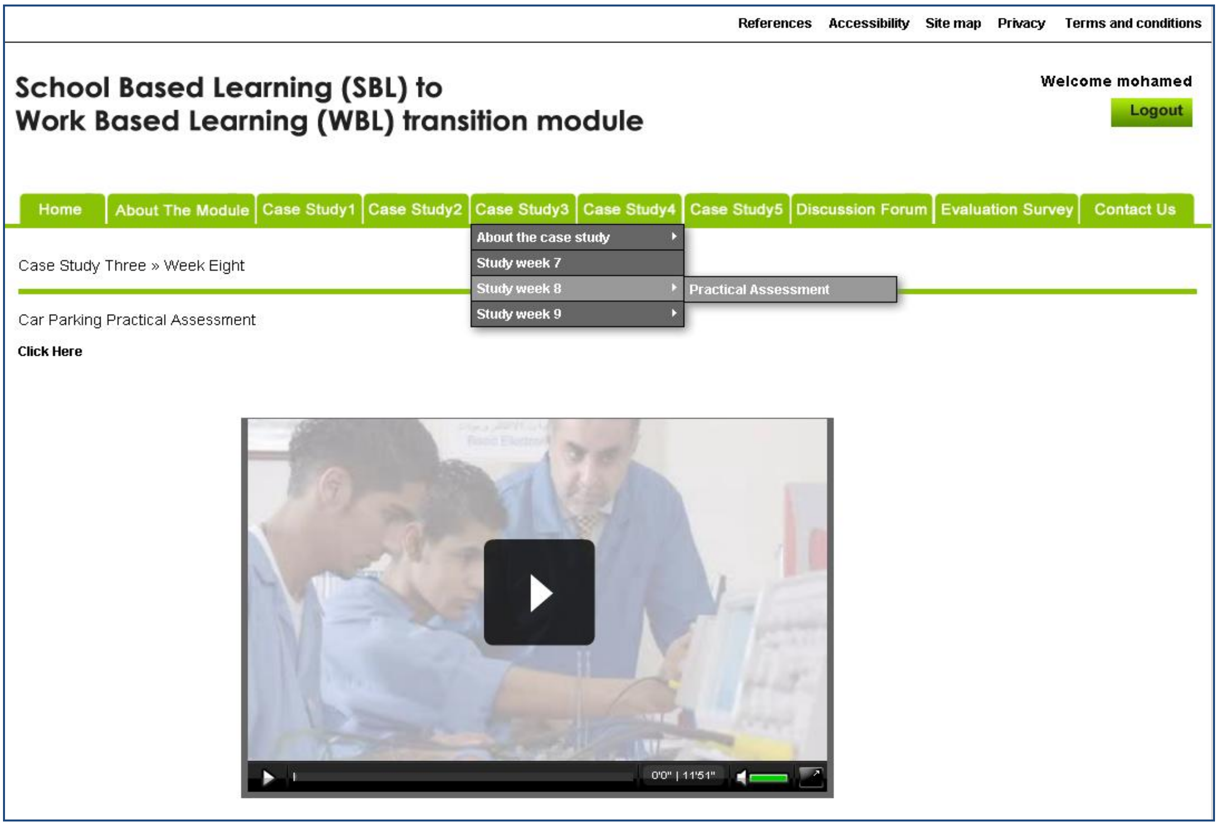

Figure 6.7: The practical assessment in study week 8

Figure 6.8 shows the learning levels employed in this case study practical assessment. The figure indicates that the practical assessment should assess the students' cognitive learning levels (LC), affective learning levels (LA) and psychomotor learning levels (LP) and skills identified in the 2D models.

- The practical assessment first measures the students' ability to identify and interpret electronic symbols and diagrams. The students recall the data and the acquired knowledge is factual so their cognitive skills (LC1) and listening and reading skills are improved. The students receive real information from the teacher (affective skills). The new attitude being developed related to the students ability to access new information and manage it (LA1). Then, they should interpret the electronic symbols and diagrams (psychomotor skills, LP1), relying on external sources of information.

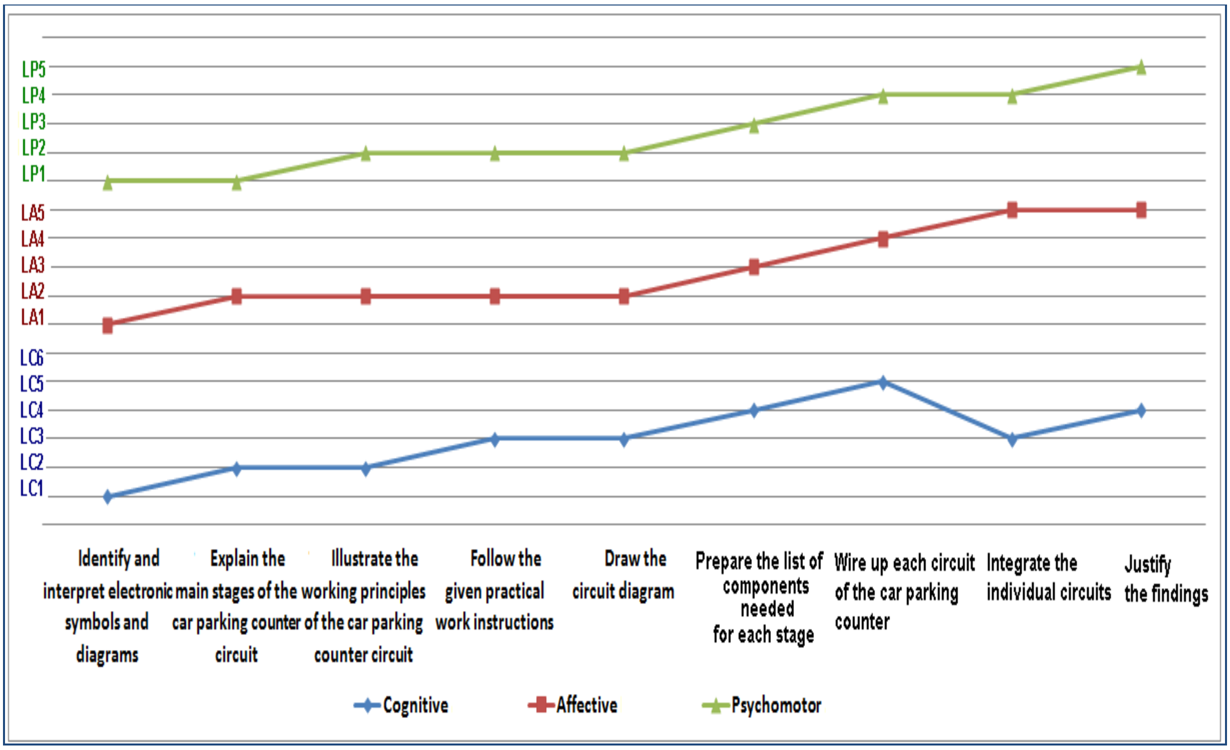

Figure 6.8: The learning levels employed in the content

- After that, students are asked to explain the main stages of developing the car parking counter circuit and illustrate the working principles. Here, the students must understand the working principles and procedures in a structured process, improving cognitive skills by gaining new conceptual knowledge (LC2). In affective skills, the students participate actively in setting the work objectives (LA2). The new attitude being developed refers to the students' ability to manage information by participating actively in establishing the working instructions. Finally, the students perform the tasks by following the instructions (LP2).

- Teachers observe the students and evaluate their ability to follow the given practical instructions and then draw the required circuit diagram (LC3), manage the work procedures (LA2), and carry out the assembly work from the given practical work instructions (LP2).

- Students are required to prepare the components for building each stage of the car parking counter circuit. The students should read and analyse the information (LC4). Conceptual knowledge is gained from this action as the students improve reading and thinking skills and understand how to solve problems. The students study and express solutions for pin configuration information (LA3). The new attitude being developed refers to the students' ability to manage information and acknowledge how to solve problems. Then, they complete the preparation of the components (LP3), relying on an external source of information.

- Students have to add the circuit diagram specifications and the prepared components to wire up each circuit of the car parking counter circuit, so their knowledge needs to be organised and structured (LC5). Regarding the affective skills, students should be innovative, by building on the generated new ideas (LA4). In the psychomotor domain skills, the students construct the work and use equipments and components and operate machines individually without assistance, based on their pre-knowledge and experience (LP4).

- Students should prove their ability to integrate the individual circuits based on the information gained previously (LC3). So, students should use their knowledge to strategically present things systematically and in a particular way. They must then be innovative, using new ideas in the operation of logic gates and solving any problems (LA5) and construct and combine components in the assembly process using previous experience with no instructions from others (LP4).

- Students should be able to justify the findings and create a new list of circuit diagrams, from information collected online and from practical applications (LC4). Also, students should able to practise various skills in real-life applications and improve practical work procedures (LA5). Finally, the assessment assesses students' ability to design new circuit diagrams without instructions (LP5).

It was obvious that the practical assessment was structured to develop the skills introduced in the 2D models for cognitive, affective and psychomotor skills. They aim to convert the cognitive and affective skills from face-to-face and online learning to psychomotor skills related to real practical work. They were designed to use technological aspects and communication channels to interact with each other and then culturally, socially, emotionally and psychologically engage in different practical and innovative learning exercises and assessments. Also, it was designed to demonstrate the students' ability to identify and interpret electronic symbols and diagrams, explain the main stages of the car parking counter circuit, illustrate its working principles, follow the given practical work instructions, draw the circuit diagram, analyse the pin configuration of digital ICs, combine the drawn circuit diagrams, discover the operation of digital logic gates using equivalent circuits, and specify types of circuit diagram. It can be seen that the assessment was organised and structured to employ both lower and higher learning levels with respect to cognitive, affective and psychomotor skills.

After completion of the practical assessment, the students are asked to complete an online and a theoretical assessment in study week 9 (see Figure 6.9 for the online assessment). They are designed to transfer the knowledge gained into long-term memory as the lower levels of cognitive psychology are converted to the higher learning levels (Anderson, 2008). Knight and Yorke (2004) added that students can use metacognitive abilities in work placement, and here the assessments should give them an opportunity to build these metacognitive skills and perform well in real work situations.

The purpose is to explore the students' thinking skills, suggest improvements, and relate the learnt competencies to real life applications.

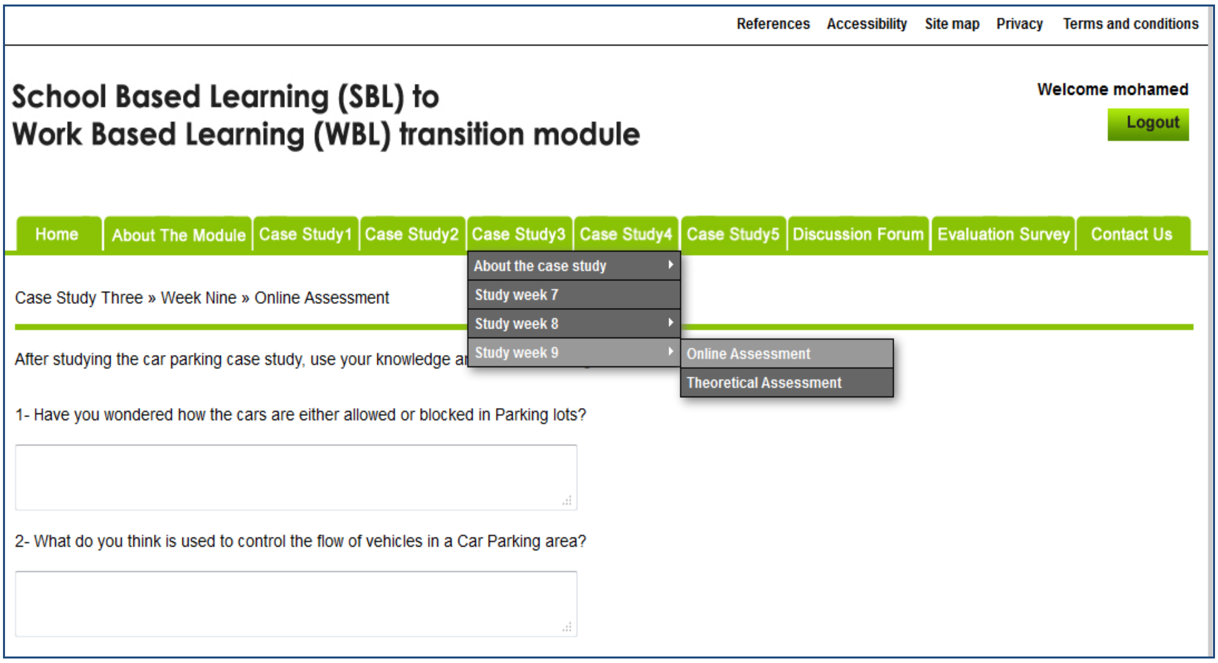

Figure 6.9: The online assessment

Learning environment - The multimedia laboratory should be fully equipped to support the use of online learning package. The Institute workshop should have workstations to support individual and teamwork learning activities during the practical session. All health and safety signs, exits and procedures must be explained carefully to the students before the session.

Mode of delivery and learning styles – Teachers should give direct instructions, supervise the students in the multimedia laboratory and provide examples helping them to understand the scientific notions presented in the online material. On study week 9 the students should perform the practical learning activities on an individual basis. So the modes of delivery merge the concepts of face-to-face, online and practical learning (Rogers, 2001) enabling the social interaction within learning activities and independent student learning. It is obvious that this learning case study was designed to combine both direct instruction and online learning materials which are suitable for a variety of learning styles.

Yeh (2007) indicated that the direct instruction lectures using technology intended to prepare students for using various sources of information (i.e. images with instructions, videos, and points to discuss verbally or using the online discussion boards). Jeanine and Donk (2007) added that lectures with direct instructions should follow four principles for successful implementation:

- Focus activity – The teacher presents warming-up information to explore students' prior knowledge. So the lecture starts with background information explained by the teacher.
- Learning objectives - The teacher tries to motivate students by introducing the learning objectives and providing the rationale of learning. The teacher should prepare the students psychologically to be effectively involved in the learning process.
- Presenting content and modelling – The teacher aims to present and deliver the learning activities in an interactive manner combining the access to websites with traditional teaching, discussion and demonstration parts.
- Checking for understanding - The teacher should ask questions to be answered by students before they move further in the case study. It should prepare the students in achieving the learning objectives and outcomes.

Allan (2007) concluded that integrated learning encourages students to fundamentally engage in social activities, assimilate into life-work applications, emotionally keep with other people, and participate in lifelong learning. Moreover, the cognitive ability of students is improved: students convert the direct instructions and online learning activities from lower thinking skills to higher thinking skills in particular learning situations.

Various learning styles are employed in delivering the content of this case study, based on students' behavioural skills and prior experience. The case study begins with the diverging learning style, acquiring face-to-face and online theoretical information which the students can observe and discuss. This information is then analysed in the assimilating learning style, and the knowledge gained reflected in the practical work and online assessments (converging learning style). Baldwin and Sabry (2010) confirmed that students respond differently to various modes of delivery depending on their learning style. So the teaching and learning sessions should have a diversity of modes of delivery in order to accommodate students' prior knowledge, cultural and social backgrounds, and behaviour and to motivate them.

6.2.2 Case Study 5 – Practical Assembly of Fluorescent Light Fitting

This case study covers problem-based learning for a real work situation and encourages individual and group learning activities.

Study week 13 - the teachers present direct instruction lecture in the multimedia laboratory using face-to-face and online discussions. Then the students are divided into two groups and each group is asked to access a wide range of sources of information presented in Figure 6.10.

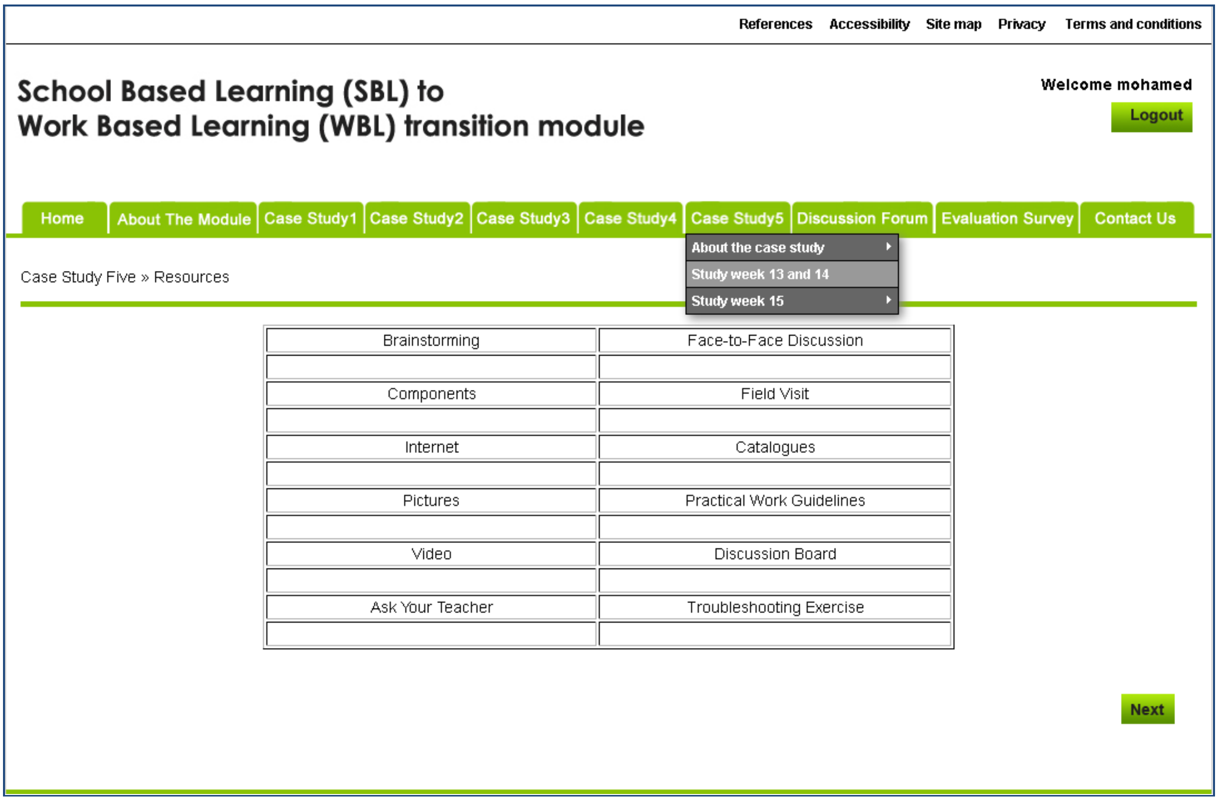

Figure 6.10: The learning content of study weeks 13 and 14

Each group should develop a strategy to assemble practically the fluorescent light fittings, test them and analyse troubleshooting causes and effects. Also each student should produce a reflective report containing personal impressions and feelings about their learning experience.

Study week 14 – each group of students is presenting their solution to the teachers. Also each student is submitting the reflective report to the teachers.

Study week 15 - students have to complete three sets of online questions in the multimedia laboratory. Their answers are stored automatically and the teachers give verbal feedback about the quality of students' answers.

On completion of the case study, the students will be able to:

- Collect specific information about the electrical components used in a fluorescent light fitting from various sources such as manuals, catalogues and the Internet.
- Identify the terminals and test the following components: fluorescent light, ballast or choke, and starter.
- Wire up a fluorescent light circuit.
- Identify and rectify faults in a fluorescent light fitting.
- Replace defective components in a fluorescent light fitting and carry out maintenance.
- Appreciate the value of investigating, comparing and evaluating the results from the case study learning activities.
- Demonstrate different thinking skills in group discussion activities during interaction with the learning activities.

Learning content design - Figure 6.10 presents the sources of information which can be used by the groups of students to achieve the learning outcomes of this case study:

Brainstorming discussions: students have some suggestion from the teachers and discuss how to draw a fluorescent light circuit diagram, prepare, select and test list of the components needed.

Face-to-face discussions: students are freely to discuss with other members of the group as well as members from other groups.

Components: students have access to the workshop store to check the availability of the required components such as wires, fluorescent tubes, chokes, starters, starter holders, and tube light holders.

Field visits exercises: the teachers are discussing with the groups of students about possible visits in various laboratory s and classrooms within the Institute. The webpage contains lists of practical elements which could be inspected by the students under teachers' supervision. The students are asked to produce short written reports which could be used for the group report.

Internet search engine: students can read information from various web sources.

Catalogues: Products and Components catalogues are available in the workshop. Students can ask teachers for a copy.

Practical work guidelines: showing the testing and assembling instructions relevant to the case study.

Video: showing an example of fluorescent light fitting from real industry.

Online discussion board: Teachers can put some points to discuss and students have to participate in giving solutions.

Ask teacher: students can send an online request or questions during the unsupervised study periods. The teachers would reply to students' emails afterwards.

Troubleshooting exercises: students are asked to solve several exercises related to fluorescent light fitting troubleshooting causes and effects.

Each group of students is free to access whatever sources of information they choose, to plan a working strategy and then complete the learning scenarios within the given period of time. For example, a group may start brainstorming sessions and participate in discussions in order to plan a work strategy where another group may use pictures to discuss and plan the work strategy. So, this is a flexible learning approach where the teachers act as facilitators to encourage the students in the learning process. More specifically, the students may use other sources such as: read the instructions, follow health and safety procedures in the workshop, communicate with other people in the group, and collect Fluorescent light specifications from the available sources and discuss and agree on the collected information with other students in the group.

Figure 6.11 shows the learning levels employed in the practical learning activities. The figure indicates that the practical learning activities should assess the students' cognitive learning levels (LC), affective learning levels (LA) and psychomotor learning levels (LP) and skills identified in the 2D models.

Each group is required to practically assemble the fluorescent light fitting and troubleshoot detection following the actions: observe health and safety precautions, identify the various parts of the fluorescent light fittings, compare the various commonly available fluorescent light fittings, assemble the fluorescent light fittings, carry out wiring of fluorescent light circuit, test and troubleshoot the circuit, and plan improvement to the circuit design.

This case study improves students' cognitive skills such as listening and reading, affective skills such as managing information, problem solving, communication skills, self-motivation, initiative, innovation and decision making; and psychomotor skills such as performing safety standards, demonstrating machine operation and device utilisation.

At the end, each student is required to submit a reflective report expressing his experience and how the learning case study would help in improving his cognitive, affective and psychomotor skills.

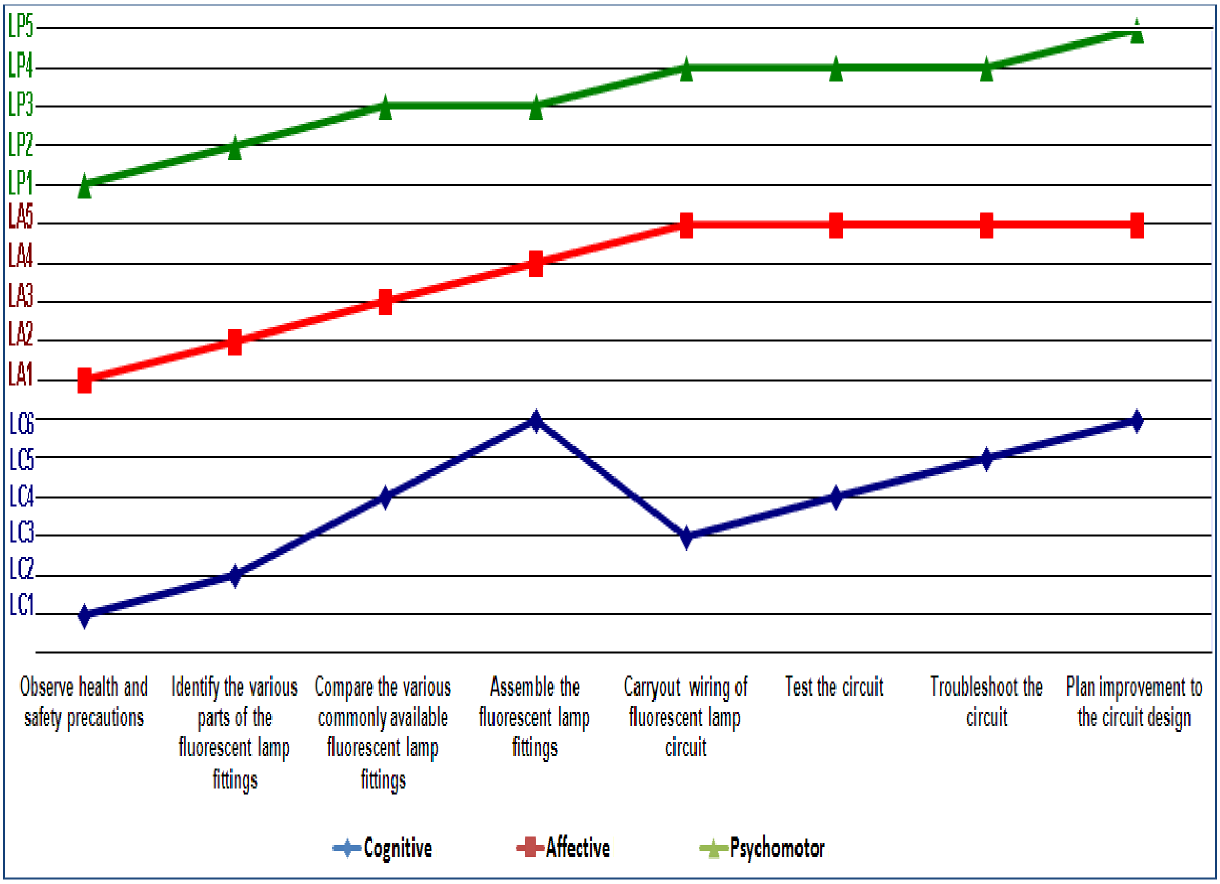

Figure 6.11: The learning levels employed in the content

The case study is first related to lower learning levels of cognitive, affective and psychomotor skills; students initially received information from teachers and then moved to the higher learning levels by converting the received information into actions.

In addition, the case study was designed for students to learn collaboratively and to provide psychological aspects of learning aimed at improving the skills introduced in the 2D models. For example, collaborative learning (Gokhale, 1995) should improve students' communication skills, problem solving, team work, critical thinking, and cultural awareness during their discussions as well as during workshop and laboratory activities. So, cognitive, affective and psychomotor skills are engaged in collaborative learning.

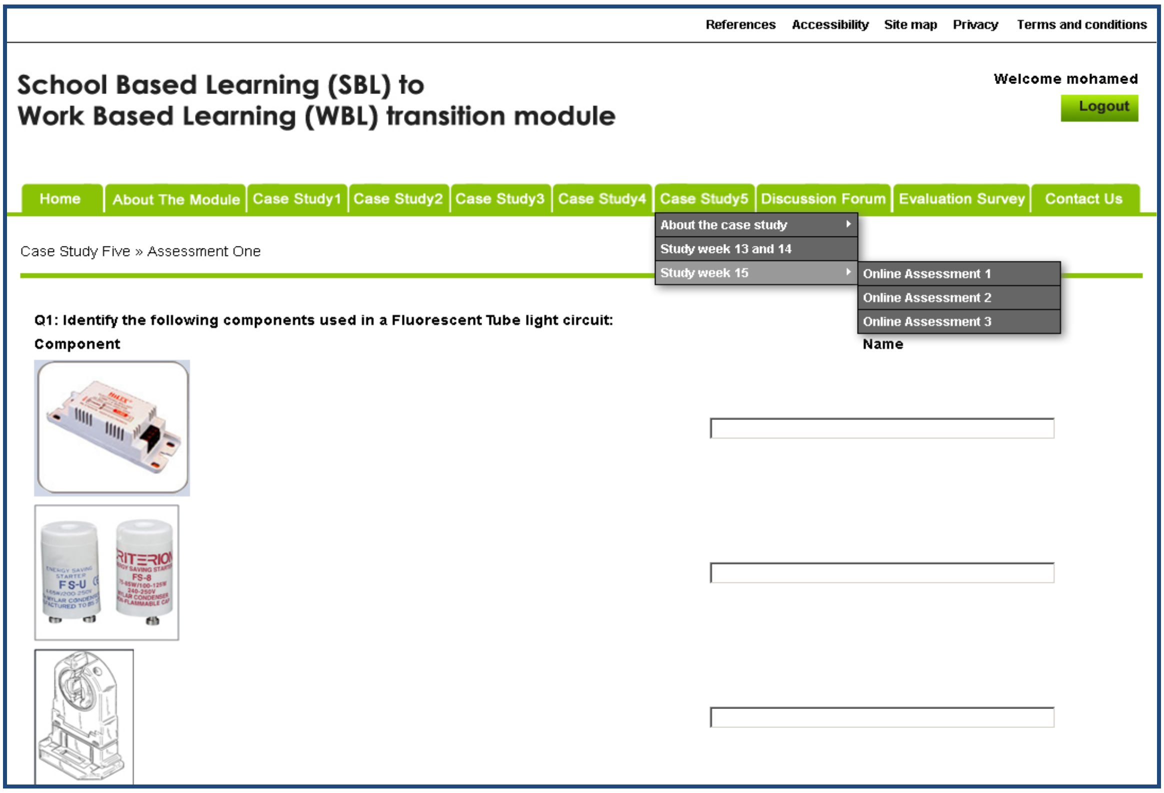

Figure 6.12: An example from first set of questions (online assessment 1)

The students have to answer three sets of questions in study week 15 under teachers' supervision:

- **Set 1 (online assessment 1 from figure 6.12)** - assesses students' ability in identifying the components used in a Fluorescent light circuit. The assessment measures students' cognitive skills related to the knowledge obtained from the case study.
- **Set 2 (online assessment 2)** – contains multiple choice questions measuring students' cognitive levels of learning.
- **Set 3 (online assessment 3)** - assesses the students' abilities in specific affective skills. The questions were prepared to test the students' evaluation of the skills used and acquired through the practical work.

The researcher has carefully formulated the questions after discussing with the other teachers and considering that this is the final assessment measuring the students' levels of knowledge, understanding and skills developed during the 14 weeks of SWT study.

Learning environment - to develop students' skills, the learning environment should be supportive; successful implementation of the learning case study depends on its flexibility. The students can move among different environments such as classroom, multimedia laboratory, practical workshop and field visit to various sections in the TVE institute within the given period of time (2 weeks) to achieve the desired learning outcomes of the case study.

Mode of delivery and learning styles - The case study combines different modes of delivery, lectures (direct instructions) and online materials and information. After the students received lectures and prepared to conduct the actions of the case study, students are emphasised have control and more learning responsibilities. Students are responsible for using the knowledge, attitude, and technical skills gained from previous learning activities and case studies and relating it to the problem introduced in a real work situation. So, students are collaboratively learning (Deignan, 2009; Barnes et al., 2011). Examples of modes of delivery in collaborative learning are e-learning materials and technical tasks where students can share experiences, critically explore and negotiate learning activities, and achieve a higher level of critical thinking. Moreover, the learning modes should be controlled by the individuals: each group of students should take responsibility and make decisions which match cognitive, cultural, social and emotional needs which they can communicate effectively with others; and construct knowledge by formulating ideas into words and by interpersonal interaction and the responses of others during the delivery of learning.

It can be seen that this case study has various learning modes which include online materials, in the multimedia laboratory, and technical tasks, in the practical workshop. For example, the students can conduct brainstorming sessions, face-to-face discussions, identify the components available in store, make field visits, and use Internet search engines, data catalogues, pictures, practical work guidelines, video, the online discussion board and the teacher (face-to-face and/or online enquiry form).

The case study has no specific learning styles to be followed, as the learning activities and mode of delivery allow the use of different styles. Palmer (2002) confirmed that this approach to learning is a mixture of teaching and learning which gives students the freedom to select the learning styles that suit their individual needs. However, it requires great care from the teacher to make sure that the students make the most of the appropriate learning style in their learning activities. Enquiry-based learning provides different means of learning, including peer learning and individual learning (Deignan, 2009; Barnes et al., 2011).

6.2.3 Conclusions of the Case Studies included in the Proposed SWT Module

Case study 1- introduced the theoretical information for different workplace skills. It provided pre-learning activities for TVE students before they accessed the remaining case studies of the proposed SWT module. The students accessed the case study online with direct instruction from the teacher and supervision in the multimedia laboratory. More details about this case study are included in *Appendix C2*.

Case study 2- contained effective online learning activities for studying the elements and operation of battery charger circuits from cars and involves collecting information about battery specifications from the customers, and choosing the appropriate components for building the circuits. More details about this case study are included in *Appendix C2*.

Case study 3 - was presented in this chapter and provided a feasible solution for students to study in an integrated learning environment (Salmon, 2000). It incorporated technical competencies on designing and the development of electronic circuits for a car parking counter in structured learning activities.

Case study 4 - aimed to design a direct on line starter circuit by groups of students. It incorporated technical competencies to develop students' problem solving skills, ability to manage information, participate in group discussions and make decisions. More details about this case study are included in *Appendix C2*.

Case study 5 - was presented in this chapter and used a problem-based learning approach for a real work situation and encouraged individual and group learning activities.

6.3 Summary

This chapter presented the design and development of the proposed SWT module. The main aim of this proposed module was to ensure that TVE students receive the necessary training required by industry before they go in work placement.

The chapter described the stages of the design for e-learning package incorporated in the proposed SWT module: user analysis; structure and representation; knowledge and communication analysis; interface and navigation design.

Also the chapter contained the explanations of the five case studies which have been included in the proposed SWT module. The emphasis was on case study 3 and case study 5 where the students were divided into groups and the problem-based learning approach was used. The design of learning activities and modes of delivery took into consideration the teaching and learning styles and the development of students' cognitive, affective and psychomotor skills.

The proposed SWT module is expected to make a major contribution to the improvement of the TVE system because it challenges the students and teachers to recognise, make informed responses, and work comfortably with the diverse requirements that they encounter in the WBL environment.

The researcher has published the following papers which are related to this chapter content:

- Design and Development of an On-Line Work-Based Learning (WBL) Module to Enhance the Technical and Vocational Education (TVE) System in Bahrain, Global Conference on Learning and Technology. Association for the Advancement of Computing in Education (AACE), Vancouver: Canada, May 2010.

- Developing an assessment strategy for school to work transition module: An example from Technical and Vocational Education (TVE) System in Bahrain, Conference ICL2010, Hasselt, Belgium, September 15 -17, 2010.

The next chapter presents the expert evaluation, the pilot implementation, and the user evaluation of the proposed SWT module.

CHAPTER 7 - Implementation and Evaluation of the Proposed SBL-to-WBL (SWT) Module

This chapter discusses the expert evaluation, the pilot implementation, and the user evaluation of the proposed SWT module. The expert evaluation was done by 48 EEE teachers who have been asked to use the developed e-learning package (prototype) and complete a check list. Then the researcher has changed the prototype accordingly to the experts' comments. A number of 5 teachers and 30 TVE students from Year 3 of study have been asked to use the improved version of the e-learning package and to complete Questionnaire 3 (user evaluation). The questions were formulated on the basis of extended quality framework (Alseddiqi and Mishra, 2011b). The responses were analysed using the descriptive statistics and principal component analysis tests available in the Statistical Package for the Social Sciences (SPSS). The analysis indicated the important quality dimensions and grouped them into new categories. The final section of this chapter discusses the evaluation quality framework proposed by the researcher.

7.1 Expert Evaluation

The e-learning prototype was developed to meet stakeholders' requirements (Hussein, 2005). The TVE teachers have used this prototype and were asked to complete a check-list about environment, web pages content and functionality. The check-list had three main parts:

- *Management of learning environment* - included aspects related to health and safety procedures, electrical equipment and machine from the Institute workshop and work stations from multimedia laboratory.
- *Management of learning content* - referred to the physical content of the web pages (such as animations, videos, simulations, icons) and navigation issues.
- *Management of website functionality* - included aspects related the main menu, case studies pages (including the attached buttons, icons, live hyperlinks, videos, animations, discussion boards and forum).

Appendix D1 contains a summary of the comments made by the experts after using the e-learning prototype. The following suggestions were made to improve the prototype:

a) The store in the Institute workshop should have all the electronic components necessary to build up the fluorescent light systems, car parking counters, etc.

b) The work stations should be connected to wireless printers and software packages such as Adobe Flash Player, Adobe Acrobat, and Real Player should be installed in the PCs.

c) The learning content should include more examples from real work environment.

d) More pictures and circuit diagrams should be inserted with clear descriptions.

e) Instant feedback for students' answers should be given for the multiple-choice questions.

f) More animations could be used (i.e. for logic gate circuits in case study 3).

g) A message should appear and inform the user that the answers were submitted successfully at the end of a test.

7.2 The Pilot Implementation

The researcher has changed the e-learning package accordingly to the experts' comments. A number of 30 TVE students from Year 3 of study from Sheikh Khalifa Institute have been asked to use the improved version of e-learning package. The students had access to case study 3 and case study 5 of the proposed SWT module for one day per week during the six weeks which were available for the pilot implementation. Two teachers were assigned for the direct instructions lectures and supervision in the multimedia laboratory and other three teachers were assigned for practical work in the Institute workshop.

In October 2010 the researcher delivered an induction programme to the students and teachers before the pilot implementation phase (See Figure 7.1).

Figure 7.1: Students' induction programme

The researcher has explained to the audience that the use of this e-learning package would enable the development of employability skills which were required by industry and students would be better prepared for the work placement requirements.

The teachers would control the website, activate the material for study weeks accordingly to the teaching plan and mentor students' participation. The students should register online and receive confirmations of usernames and passwords via emails.

After the successful implementation, the proposed SWT module will be added to the study plan in the academic year 2012/2013 in the four TVE institutions and will have a summative assessment component.

The researcher used direct observation to evaluate teachers' and students' interaction during the pilot implementation. Reflective notes were produced after every observation session and included comments about students' and teachers' behaviour, reactions and engagement with online learning materials (using the multimedia laboratory) and practical applications (using the Institute workshop). Samples of these reflective notes were included in *Appendix D2*.

It was considered the Hawthorne effect because people try to perform better when someone observes them (Drury, 1992). Hawthorne effect referred to a situation in which an individual's behaviour is positively changed by the observation itself (Leonard and Masatu, 2006).

Cooper and Schindler (2008) underlined that direct observation allowed collection of certain types of information in a systematic, purposeful, planned and well executed manner. They identified three steps in direct observation, namely record analysis, physical condition analysis and physical process analysis.

The first stage recorded the necessary information about the existing TVE system; for example, the researcher recorded information about the TVE stakeholders, the existing learning resources in EECs, and the TVE institutions' infrastructure. This record analysis was based on historical information from previous TVE studies.

The physical condition analysis was used to determine the implementation requirements.

The physical process analysis was to progress, monitor, and evaluate the pilot implementation:

- Ensuring that photographic evidence was taken and some were presented in *Appendix D2*.

- Making sure that the learning process of the proposed SWT module took place.
- Providing evidence of students' learning during the pilot implementation.
- Monitoring students' attitudes and behaviour in the process of learning.

7.2.1 Case Study 3: Design and Development of Electronic Circuits for Car Parking Counter

The case study was broken down into theoretical learning activities (for knowledge understanding and attitude acquisition) and practical learning applications (for converting knowledge and attitude into technical skills applications). The students had access to a variety of information sources and communication tools (such as direct instructions, online learning, and examples of practical applications). The theoretical learning activities were delivered using the multimedia laboratory and the practical learning was carried out in the Institute workshop.

Study week 7- the teachers presented the outline, objectives and learning outcomes of the case study. Then they introduced background information about the online learning materials and Institute workshop environments. The students accessed the web pages related to this case study online with direct instruction from the teachers in the multimedia laboratory. The teachers felt that the students had good experience in accessing online learning materials. The students found the explanations related to this case study to be attractive (especially the animations used to explain the working principles for car parking counter circuits and operation of logic gates in counters). The idea was to link students' understanding of logic gates to a real life example.

It was visible that the online case study gave students a better idea about a real work environment. Also the students were asked to contribute to the online discussion forum where they can improve their level of knowledge and understanding by peer learning.

Study week 8- the teachers presented a video containing practical work guidelines which was played on the Smart Board (Interactive White Board) of the multimedia laboratory. After that, the students were asked to watch the video individually using the laboratory computers. Some students asked questions on the availability of components in the store of Institute workshop. Some students agreed that the video clarified the idea of work placement, presenting the skills and attitude they should have acquired, and motivating them to work in a real environment. In addition, teachers believed that using real videos from the industry was appropriate and easily understood by the students.

The students were asked to print out the practical guidelines and assessment from the online webpage. The students read the guidelines and indicated that the information was presented in a structured manner and easily understood and followed.

Then the students went to the Institute workshop where the teachers explained the health and safety procedures before the practical applications. The students listened to the teacher's explanations, watched pictures, and participated in face-to-face discussions with the teachers. The teachers stressed that health and safety procedures were vital information which must be acquired by the students. The teacher's direct instructions using technology contributed effectively to conveying the information to students clearly. The students' interaction was limited in the discussion; most of them were only listening to the teachers. However, they were asked to answer questions related to health and safety procedures so their level of knowledge was tested in this way.

Then the students were asked to perform practical tasks individually under teachers' supervision. It was noticeable that the students could use the theoretical information and practical work guidelines instructions for these activities. They were self-motivated, with the ability to test and analyse the practical situations. They also solved problems, listened to teachers' supervision, produced new ideas, and participated in making accurate decisions.

The teachers had a practical work checklist in observing students. The results indicated that the students were able to convert the online theoretical information and work instructions into practice. The students were motivated, have improved their learning experience, and were prepared for the real industrial workplace. Other students were able to analyse complex practical situations and make appropriate decisions.

Some students complained that they were not given enough time to complete the learning activities. It was suggested that the video of practical work guidelines should be watched and discussed in study week 7 to allocate more time for the practical assessment in study week 8.

Study week 9- the students had to complete online and handwritten assessments in the multimedia laboratory under teachers' supervision. The online assessment aimed to evaluate the students' knowledge and understanding of theoretical notions. The teachers explained that the assessment was to encourage the students' learning perspectives, introduce new proficiencies related to reality, and support them in transferring to the new experience. The students could access the online learning materials and Internet search engines. So the students could demonstrate their proficiency in using online materials to solve practical problems.

The handwritten assessment focused on students' technical competencies and understanding of the operation of electronic circuits and logic gates. So this assessment improved their thinking skills, creativity and problem solving capability.

7.2.2 Case Study 5: Practical Assembly of Fluorescent Light Fitting

This case study covered problem-based learning for a real work situation and encouraged individual and group learning activities.

The case study included various tasks and the teachers divided the students into groups for cooperative learning. The students could access different sources of information and cooperate with each other in different learning activities. The teachers acted as facilitators to encourage the students in the learning process.

Study week 13 - the teachers explained the learning objectives and outcomes in the multimedia laboratory. Also, face-to-face discussions enabled the students to socially engage with the learning activities and acquire the necessary information.

Then the students were divided into groups and each group was asked to access a wide range of sources of information from the first web page of this study week.

Some students were concerned about the allocated time for accomplishing this case study especially because this was a new approach to learning. The teachers underlined that the information was well organised and structured and students would be mentored and monitored by the teachers. Also the students could complete some learning activities during their free time and teachers' guidance and supervision would be provided when needed.

Here are some of researchers' observations regarding students' and teachers' reactions when using the available sources of information included in the webpage:

- *Online discussion forum:* Some students accessed the discussion forum and focussed on specific subjects through an interpersonal dialogue where the sharing of ideas helped them to develop their own thinking. The students worked collaboratively, were motivated to access information, participated socially, and exchanged information with each other. Also, some students sent online questions during the unsupervised study periods and teachers responded to students' emails.

- *Components:* students have chosen the electrical components necessary to finalise their practical work under teachers' supervision. Then they went to the Institute store and asked for the required components. So they have developed their communication and team working skills.
- *Field visits exercises:* the teachers discussed with the groups of students about possible visits in various laboratory and classrooms within the Institute. The webpage included lists of practical elements which could be inspected by the students under teachers' supervision. For example, a group of students and one teacher visited the career guidance office and inspected the practical elements included in the webpage. They gathered the necessary information to answer the questions of the practical element available in the webpage. The students appeared to be socially involved and shared knowledge by communicating with each other. They collected the fluorescent light components specifications and stated the probable faults. It was observed that students' participation in field visits strengthened their knowledge and developed their cognitive skills in reading, writing and listening, and developed their management of information and communication skills.
- *Internet search engine:* students have developed their problem solving skills when accessing the Internet and search for high quality information from different websites. They had to define the problem, search for potential solutions, and discuss solutions with their peers through the online discussion forum.
- *Catalogues:* students developed their technical skills by reading technical catalogues printed by various industrial companies. So they had access to different catalogues which provided clear and well organised content for finding solutions to the given tasks.
- *Practical work guidelines*: The relevant webpage contained an attached copy showing the testing and assembling instructions of fluorescent light fitting. The students indicated that the guidelines were clear, easy to understand and was helpful in completing the practical work.
- *Video:* An example of fluorescent light fitting from real industry provided relevant information for the groups. The notes taken by some students (while watching the video) have been used in developing the solutions for the practical work.
- *Online discussion board:* Teachers created forums on specific topics and the students accessed the topic, read the answers submitted by others and posted their own replies. So this discussion board allowed the students to communicate with each other in an asynchronous way. Discussions were logged and organised into threads that contained main

posting headings and all related replies. Students underlined that the groups worked better when using this facility because they could receive information regarding the project problem, participate actively in the team's discussion, coordinate the learning activities in teamwork, provide examples from previous experience, implement the practical work, and write reflective notes. The students' participation in this study week was greater than what they performed during the study weeks for case study 3 because they have received the training and guidance on using this online discussion board and become more familiar with it. Also they have started to recognise more the importance of engaging in group discussions which enable the development of cognitive and affective skills.

- *Troubleshooting exercise:* students were asked to analyse the causes and effects related to fluorescent light fitting troubleshooting exercise. The teachers felt that this exercise encouraged the students to gather relevant information, cooperate with each other in groups in order to find effective solutions. It was observed that this exercise enabled the development of students' cognitive and affective skills required by industry and strengthened their personal relationships. In addition, the teachers noticed that this exercise improved the students' ability to analyse real situations, and provide creative ideas.

Study week 14 - each group of students demonstrated to the teachers their practical work in the Institute workshop. The teachers asked questions and checked the students' understanding against the case study learning outcomes. They observed that the students became more aware of the process of learning and familiar with the available learning opportunities. This was noticed in their contribution with the group, in planning for a work strategy to assemble fluorescent light fittings, test the fluorescent light and attempt problem solving.

Also each student was required to submit a reflective report to the teachers. The reflective report enabled the students to express their feelings and emotions towards working in groups when solving problems related to real work environment. Some students claimed that case study 5 (with online learning materials and practical exercises) increased their work load and that they needed extra time to accomplish the work (compared to the existing modules from TVE system). Other students liked this approach to learning because they could have more time for group discussions and better opportunities for personal contributions.

Most of the students found it interesting to interact with technology (such as Internet browsing) to search for suitable technical answers. The teachers also agreed with this new approach to TVE learning processes because the students could gain new skills required by modern industry.

Study week 15 - students were authorised to access and complete three sets of online questions in the multimedia laboratory. The students could access the online learning materials related to case study 5. Their answers were stored automatically and the teachers gave immediate and explicit verbal feedback about the quality of students' answers for this formative assessment. It was useful for the teachers to get a better idea about students' understanding during the SBL programme when timely adjustments can be made to ensure students achieve targeted standards based learning goals within a set time frame. The teachers agreed that assessments tested the students' levels of learning related to Bloom's taxonomy. Some students said that the questions were challenging and were grateful to have access various sources of information (such as the online learning materials and Internet search engines) when answering the questions. It was obvious that the students acquired a variety of cognitive and affective skills. However, the teachers believed that these questions should be included in the summative assessment so this might convey a sense of learning progress to the students and could improve the motivation of students when they received specific feedback related to the case study outcomes.

7.2.3 Researcher's Reflections on Pilot Implementation

The researcher observed that the efficiency of teaching and learning processes was improved by the pilot implementation of SWT module which employed a variety of modes for delivery of the learning content. The researcher summarised the positive outcomes obtained from the pilot implementation, and its limitations.

Positive outcomes- students understood that the case studies of the proposed module were delivered to improve their knowledge, understanding and skills required by industry. The teachers were aware that each student must have prior knowledge and experience before becoming involved in the learning case studies.

The learning activities included in the case studies aimed to enable the development of cognitive, affective, and psychomotor skills considering both lower and higher learning levels (see Chapter 4). During the implementation phase, it was noticed that the participants were involved in different online, face-to-face and practical learning activities. The researcher observed that students' level of participation to learning activities has increased in case study 5 because they become more familiar with the online materials, different sources of information for group work. The design of learning activities considering the 2D model for affective domain skills gave the teachers the opportunity to encourage their students to be motivated, involved in team working and problem-solving activities, and share personal views, beliefs and emotions. These findings confirmed Shephard's (2008) suggestion to use Bloom's affective domain in the design of measurable learning activities in the same way that educators have designed cognitive domain learning objectives and learning activities.

Limitations - only six weeks were available to implement the case studies of the proposed SWT module. Also, it was obvious that the direct observation might not give all the necessary information to measure the effectiveness of the proposed SWT module. So the researcher decided to collect more information from quantitative data analysis. A user evaluation (Questionnaire 3) was carried out in order to generate appropriate conclusions and suggest future recommendations for this research.

7.3 User Evaluation

A number of 30 TVE students from Year 3 of study have been asked to use the improved version of e-learning package and to complete Questionnaire 3 (user evaluation). The questions were formulated on the basis of an extended quality framework developed by the researcher (Alseddiqi and Mishra 2011b; Alseddiqi et al., 2012).

The user evaluation was facilitated by the teachers who supervised the students using the pilot implementation of the proposed e-learning package. The aim was to receive critical information in evaluating different perceptions about the effectiveness of the proposed SWT module. The questions were designed with opinions and attribute data variables (Saunders et al., 2003). Each question was designed in such a way that it would engage the respondents' interest, encourage co-operation and extract reliable and accurate data. They were carefully selected to test a variety of conditions, and were grouped according to the purpose of this questionnaire. A copy of the questionnaire is presented in *Appendix D3*.

A 5-point Likert Response Scale (Cooper and Schindler, 2008) was adopted for Questionnaire 3 and the respondents had to choose between these options:

1- Strongly agree, 2- Agree, 3- Neither agree nor disagree, 4- Disagree, 5- Strongly disagree.

7.3.1 The Extended Quality Framework

Wang and Strong (1996) initiated the original work for setting standards for information quality frameworks. The purpose was to critically evaluate users' viewpoints towards the content of a learning system and give priority to quality as an evaluation of excellence. It was obvious that pedagogical and technological aspects could not continually improve without a quality evaluation process.

The Extended Quality Framework				
Quality of pedagogical content				Quality of technological features
Intrinsic Content Quality	*Contextual Content Quality*	*Integration Content Quality*	*Representation Content Quality*	
Believability	Value-added	Integration of skills	Interpretability	Accessibility
Accuracy	Relevancy	Cultural Awareness	Ease of Understanding	Security
Objectivity	Timeliness	Personal and social attributes	Depth of Knowledge	Response Time
Reputation	Completeness	Emotional Intelligence	Representational Verifiability	Availability
Consistency	Amount of Information	Reflection Skills	Motivation	Interactivity

Figure 7.2: The extended quality framework

Alseddiqi and Mishra (2011b) proposed an extended quality framework that would enable the measurement of the effectiveness for the engineering courses learning content (see Figure 7.2). This framework contained 25 quality dimensions:

- 18 covered the quality dimensions identified in the existing information quality frameworks (Wang and Strong, 1996; Knight and Burn, 2005; Alkhattabi, 2010).
- 7 new quality dimensions related to employability skills required by modern industry.

The extended framework would be useful in determining adequacy of the new SWT module in providing workplace proficiencies, preparing TVE students for work placement, providing effective teaching and learning methodologies, integrating innovative technology in the process of learning, meeting modern industrial needs, and offering a cooperative learning environment for TVE students.

Table 7.1 shows the 25 quality dimensions of the extended quality framework. They were divided into quality of pedagogical content and quality of technological features and the cells with blue background show the new quality dimensions added by the researcher. The quality dimensions of the extended quality framework were used to design Questionnaire 3 and the questions were related to the pedagogical and technological features of the proposed SWT module. The responses were analysed using the descriptive analysis and principle components analysis available in SPSS.

Table 7.1: The quality dimensions of the extended quality framework

The quality of pedagogical content	
Intrinsic content quality	
Believability	The learning content provides updated and believable information to meet modern industrial needs
Accuracy	The learning content provides scientific and accurate information
Objectivity	The learning content has impartial learning case studies
Reputation	The learning content provides an effective quality model as a benchmark for producing future EECs
Consistency	The learning content has consistent information which is not available in other learning modules
Contextual content quality	
Value added	The learning content adds value to engineering courses
Relevancy	The learning content contains relevant information to modern industrial needs
Timeliness	The learning content contains up-to-date learning case studies
Completeness	The learning content has information applicable to meeting TVE and industrial objectives
Amount of information	The learning materials contain an appropriate amount of information in a structured manner
Integration content quality	
Integration of skills	The learning package provides clear theoretical information instructions for practical applications
Cultural awareness	The learning package conveys personal beliefs which are contrasting to the cultural beliefs of others
Personal and social attribute	The learning package contains learning activities which allow students for social presence and social engagement
Emotional intelligence	The learning package includes learning activities that students participated in groups and reached a final decision emotion
Reflection skills	The learning package allows students to assess themselves for personal development
Representation content quality	
Interpretability	The learning content has clear and appropriate language, structure, and instructions
Ease of understanding	The module arranges the information in a way that can be easily understood
Depth of knowledge	The learning package has different learning activities for developing knowledge understanding
Representational verifiability	The learning package is flexible and information can be modified when required
Motivation	The learning package has different learning activities with various modes of delivery to attract students and motivate them to learn
Quality of technological features	
Accessibility	The module can be easily accessed on-line and/or in the multimedia laboratory
Security	The access security features are enabled to protect the content
Response time	The web pages are effectively responding; flexibility in browsing and moving from one learning activity to next
Availability	The information is available and can be accessed as scheduled in the module's plan
Interactivity	The web pages have different interactivity features such as videos and animations

The analysis should indicate different perceptions about the effectiveness of the proposed SWT module and to find possible relationships between factors (quality dimensions) that could be helpful in grouping them; therefore, it would be easier for the researcher to develop a new evaluation framework for engineering courses.

7.3.2 Descriptive Statistical Analysis of Quality Dimensions included in Questionnaire 3

This section analysed the teachers' and students' answers to Questionnaire 3 which contained 25 questions (one question for each quality dimension included in the proposed extended quality framework – see Table 7.1). The version 18 of SPSS package was used to analyse the answers for Questionnaire 3 and here are the conclusions of analysis.

✓ **Quality Dimension 1- Believability**

Figure 7.3 shows that 67.2% of the respondents agreed that the learning package provided updated and believable information which meets modern needs for industrial skills. So the proposed module has up-to-date pedagogical content carefully selected in accordance with the learning objectives of TVE and industrial requirements.

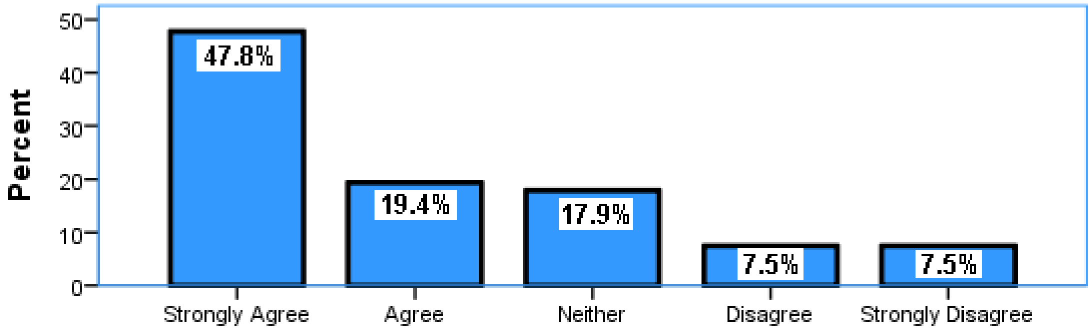

Figure 7.3: Believability

✓ **Quality Dimension 2- Accuracy**

Figure 7.4 shows that a total of 70.2% of the respondents agreed that the content of the learning package was scientific and accurate. This was due to researcher's expertise on electrical engineering topics and his consultations with the other teachers who performed the expert evaluation of the prototype so the version of the e-learning package was improved.

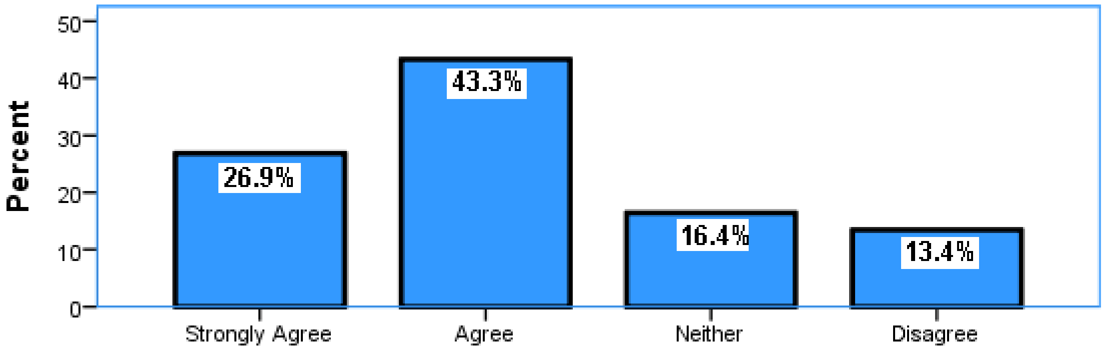

Figure 7.4: Accuracy

- ✓ **Quality Dimension 3- Objectivity**

Figure 7.5 shows that 73.3% of the respondents agreed that the learning package case studies were impartial. This proved that the choice of case studies has been made by considering various aspects of practical work from industry so the quality of student' learning experiences was improved by using the e-learning package.

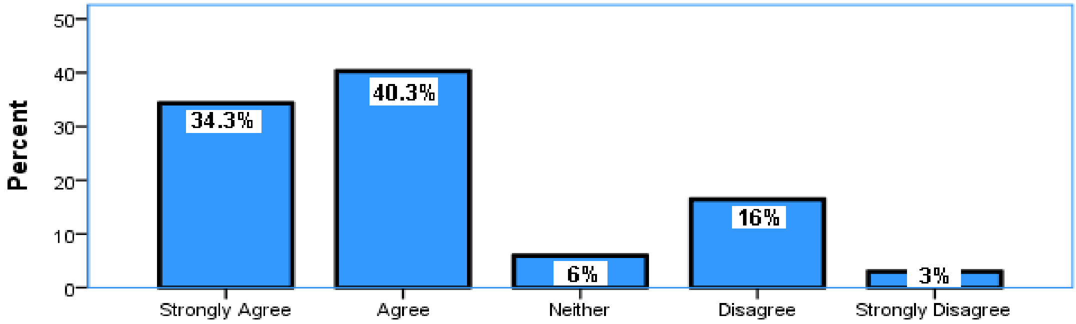

Figure 7.5: Objectivity

- ✓ **Quality Dimension 4- Reputation**

Figure 7.6 shows that 68.4% of the respondents agreed that that the learning package gave effective information and could be used as a benchmark in developing the engineering courses in the TVE system. The researcher suggested that full implementation of the proposed SWT module was required to examine the learning package and then decide to use it or not as a benchmark for engineering courses in the TVE system.

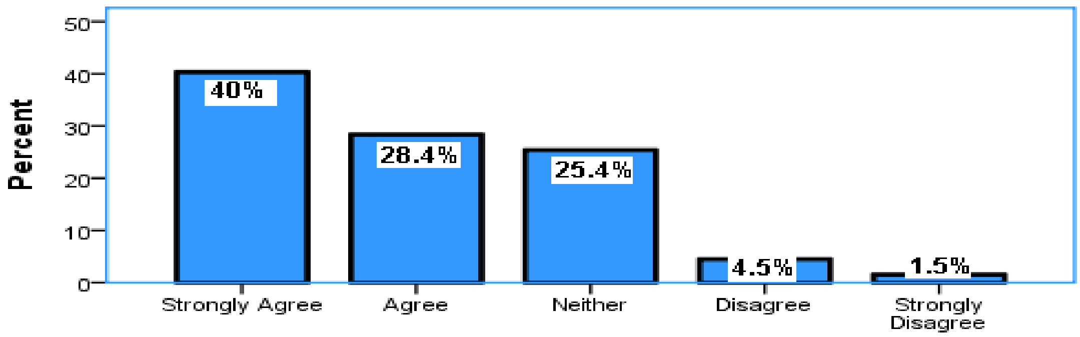

Figure 7.6: Reputation

- ✓ **Quality Dimension 5- Consistency**

Figure 7.7 shows that 88.1%, agreed that the learning package had consistent information and incorporated innovative learning case studies. Also, it was obvious that the flow of the information was structured properly in the proposed module and had consistent information which was related to real work applications.

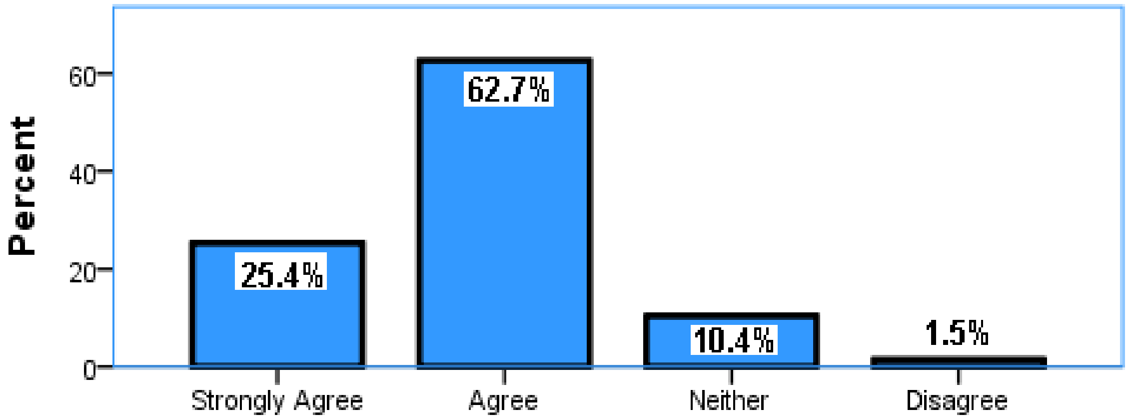

Figure 7.7: Consistency

- ✓ **Quality Dimension 6- Value-added**

Figure 7.8 shows that 74.6% of the respondents agreed that the proposed SWT module added value to the existing engineering courses in the TVE system. The proposed module had variety of modes of delivery, learning styles, and learning activities which were innovative and added value to the existing TVE system.

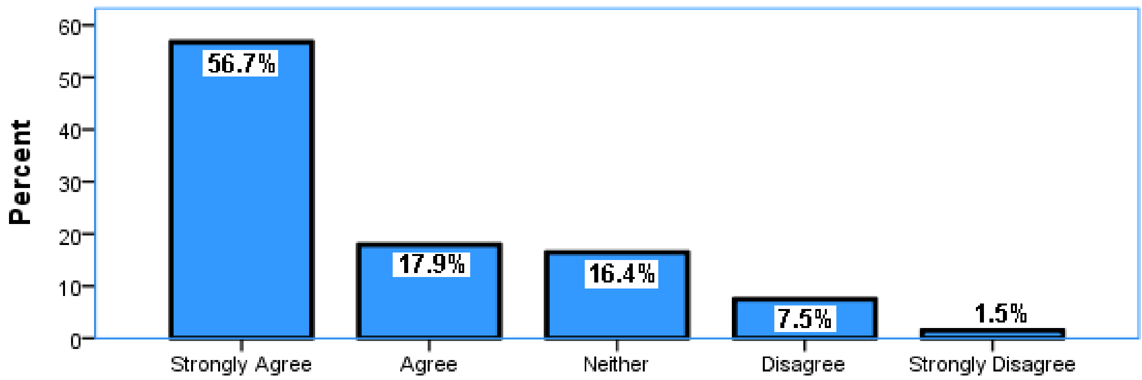

Figure 7.8: Value-added

- ✓ **Quality Dimension 7- Relevancy**

Figure 7.9 shows that 85.1% of the respondents agreed that the learning package was designed in order to enable the development of modern industrial skills. The module contained various case studies relevant to real work applications.

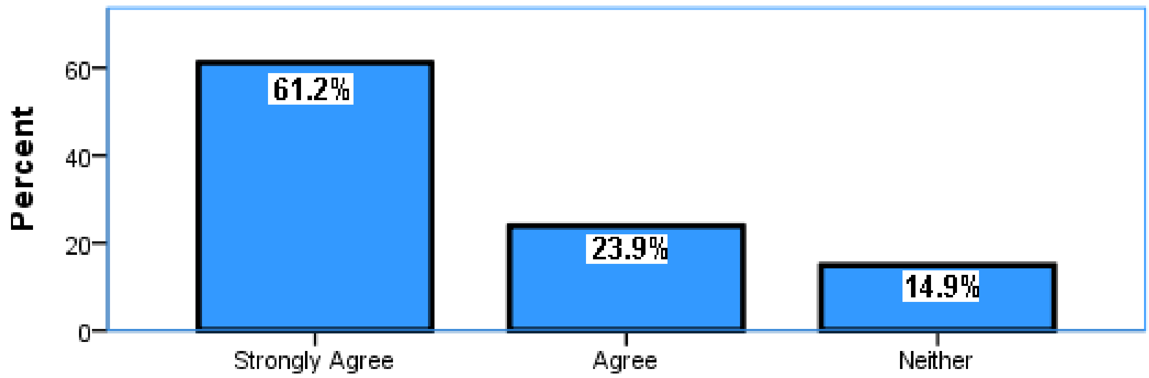

Figure 7.9: Relevancy

- ✓ **Quality Dimension 8- Timeliness**

Figure 7.10 shows that 49.2% of the respondents agreed that the amount of time allocated to deliver the proposed module was appropriate. However, 47.8% were unsure with this quality statement. Only six weeks were allocated for the pilot implementation so it would be necessary to estimate again the amount of time which should be allocated to deliver the proposed module in the future.

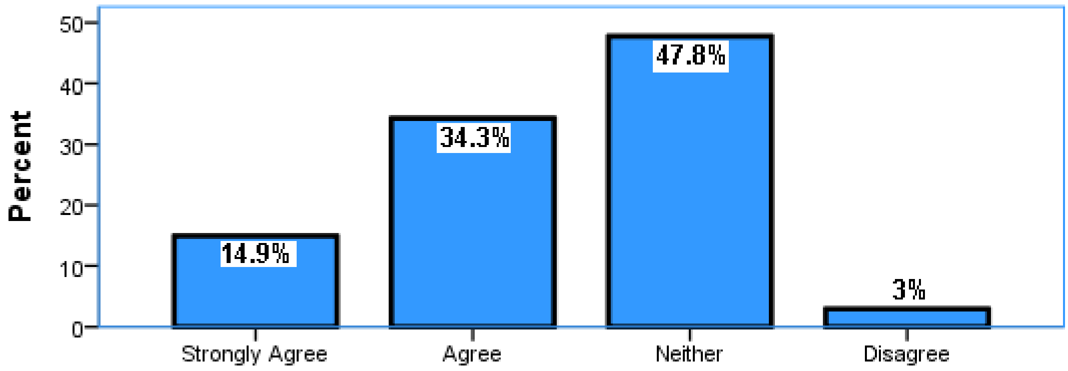

Figure 7.10: Timeliness

- ✓ **Quality Dimension 9- Completeness**

Figure 7.11 shows that 94% of the respondents that the proposed module had clear aims, objectives, and learning outcomes. It was obvious that the module's content was designed to meet internal objectives (TVE objectives) and external objectives (industrial requirements).

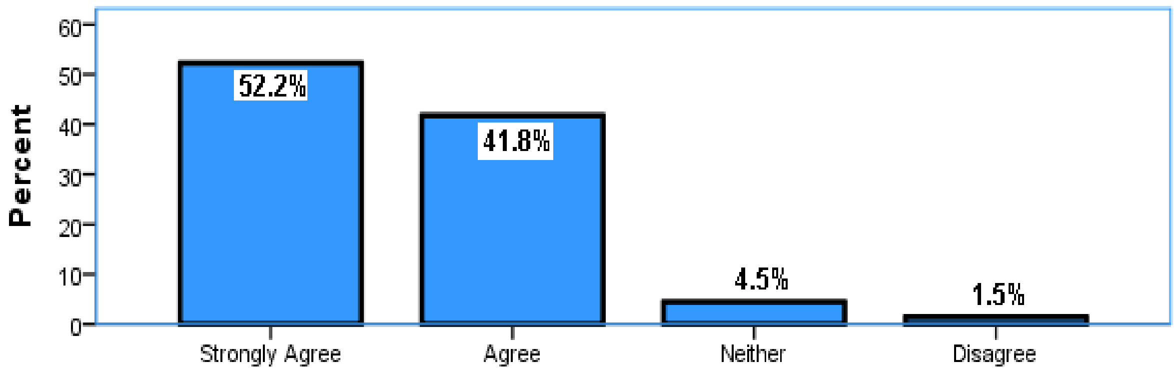

Figure 7.11: Completeness

✓ **Quality Dimension 10- Amount of information**

Figure 7.12 shows that 58.2% of the respondents agreed that they had received an appropriate amount of information during the six weeks of teaching and learning. However, 41.8% stated that the module had a large amount of information and was difficult to be completed in the allocated time plan. The researcher suggested having future consultations with the TVE teachers in order to review the amount of information and make changes for future improvements to the proposed SWT module.

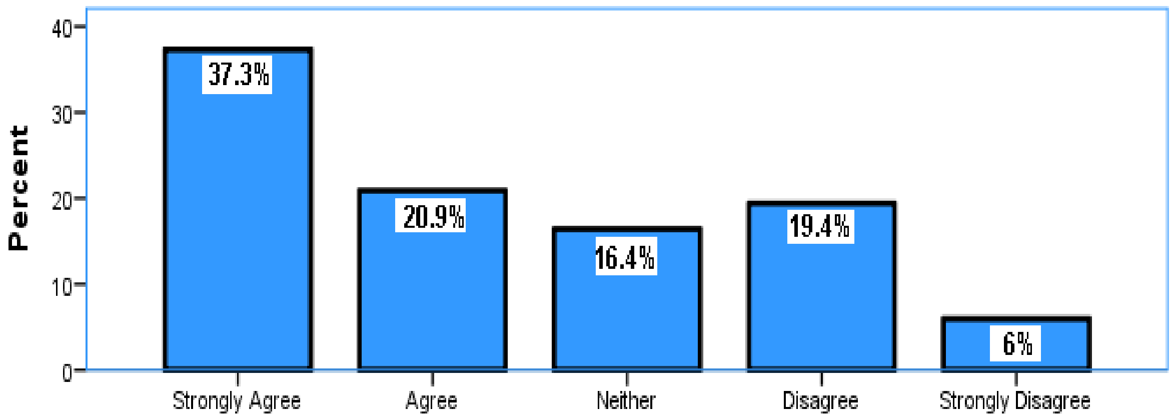

Figure 7.12: Amount of information

✓ **Quality Dimension 11- Integration of skills**

Figure 7.13 shows that the respondents agreed that the proposed module developed their employability skills. The theoretical and practical learning applications enabled the development of students' cognitive, affective, and psychomotor skills.

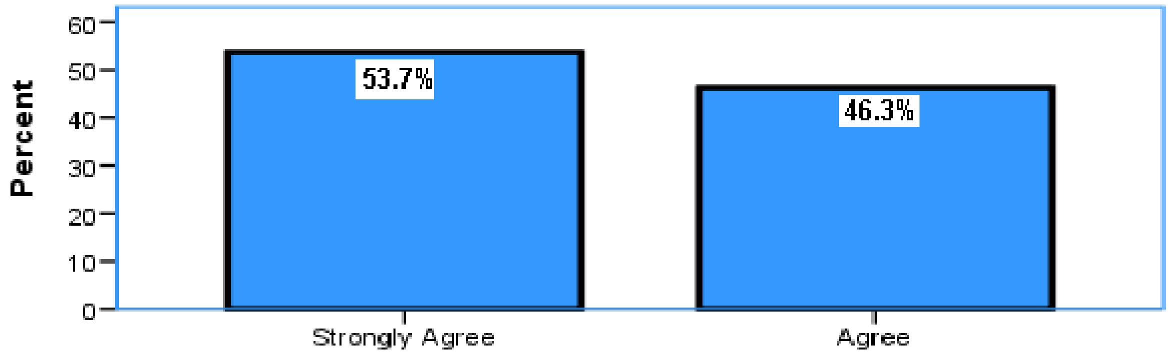

Figure 7.13: Integration of skills

- ✓ **Quality Dimension 12- Cultural awareness**

Figure 7.14 shows that 89.5% of the respondents agreed that the proposed module conveyed their personal beliefs. The proposed module had collaborative learning activities which strengthened the communication between students and developed students' cultural awareness and understanding of the real work environment.

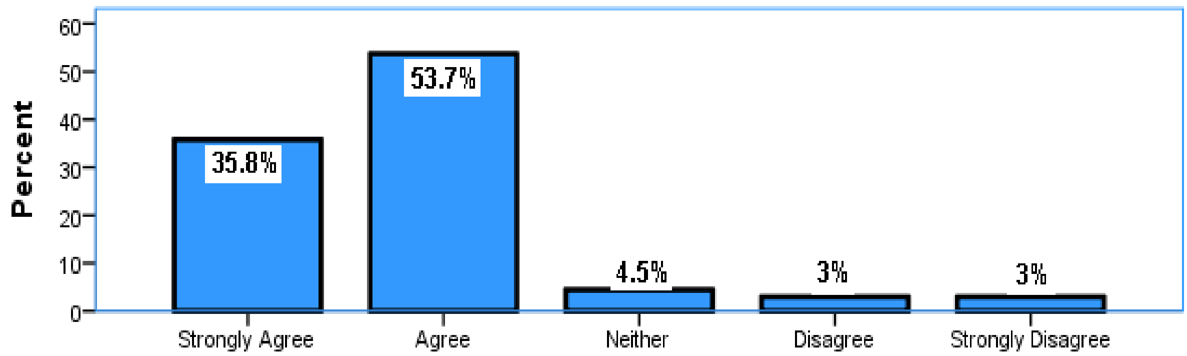

Figure 7.14: Cultural awareness

- ✓ **Quality Dimension 13- Personal and social attributes**

Figure 7.15 shows that 97% of the respondents agreed that the proposed module allowed them to understand the concept of fair play, to accept success and failure, and co-operate in group situations. The proposed module contained learning activities which enabled students to discuss and collaborate with each other through various means of communication (such as discussion forum, online discussions, and face to face meetings).

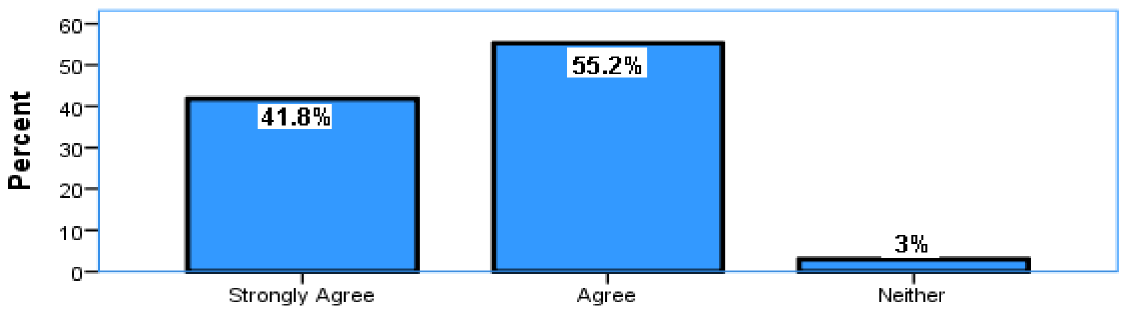

Figure 7.15: Personal and social attributes

- ✓ **Quality Dimension 14- Emotional intelligence**

Figure 7.16 shows that 83.6% of the respondents agreed that the proposed module contained attractive learning activities to develop their emotional intelligence attitude. So, the students were motivated to work in a variety of learning activities, communicate effectively with each other, and construct knowledge by formulating ideas into words and by interpersonal interaction and the responses of others during the delivery of learning.

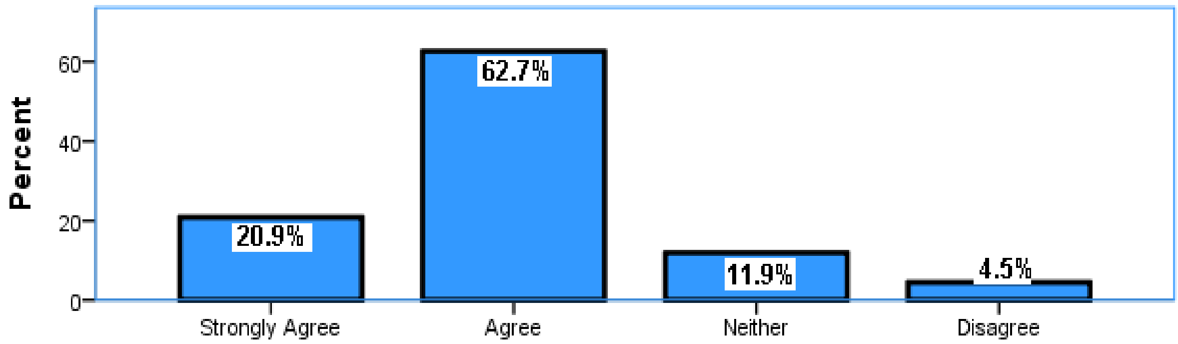

Figure 7.16: Emotional intelligence

- ✓ **Quality Dimension 15- Reflection Skills**

Figure 7.17 shows that 97% of the respondents agreed that the module contained learning activities and exercises to develop their ability in writing reflective notes. The students were encouraged in different learning activities and then asked express their impressions, feelings and emotions in reflective notes.

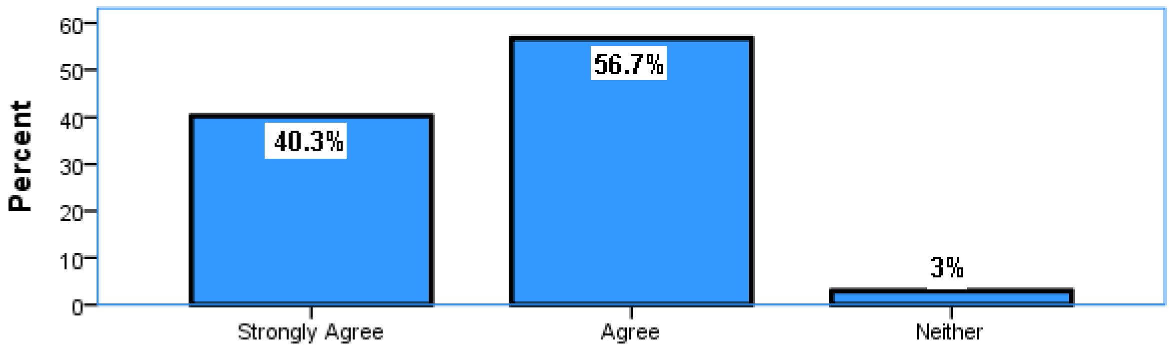

Figure 7.17: Reflection skills

- ✓ **Quality Dimension 16- Interpretability**

Figure 7.18 shows that 88.1% of the respondents agreed that the proposed module had clear and appropriate language, structure and instructions. The learning activities were cumulatively structured from lower to higher learning levels. For example, the students were asked to read online learning materials and watch a video of the practical work guidelines before they started the practical work in the Institute workshop.

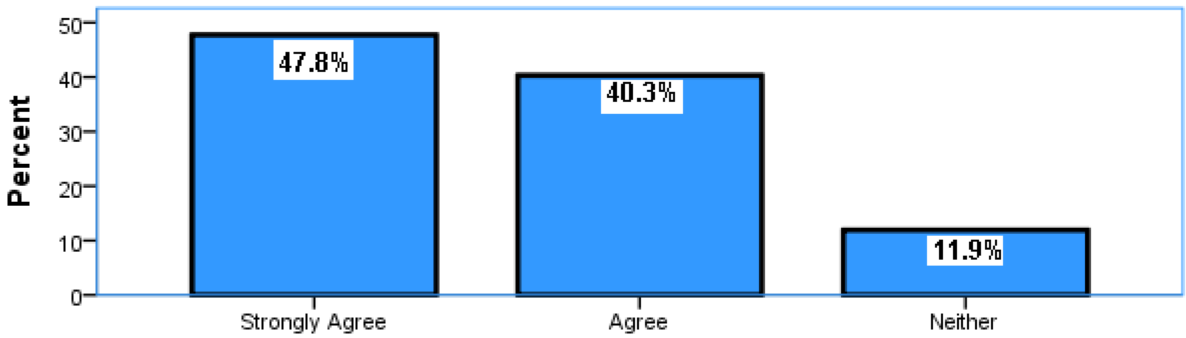

Figure 7.18: Interpretability

✓ **Quality Dimension 17- Ease of understanding**

Figure 7.19 shows that 62.7% of the respondents agreed that the information included in the module was easily understood. The proposed module targeted TVE students in the EEE Year 3 aged 15-18 years so the language used in the e-learning package aimed to meet the different needs of students.

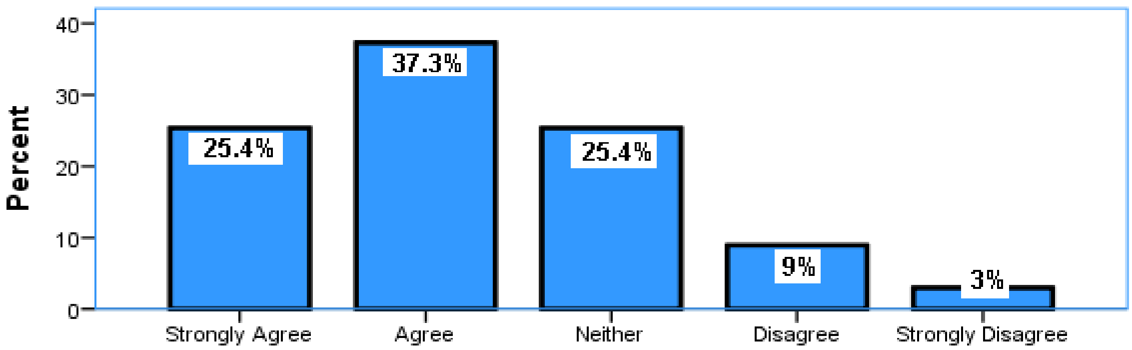

Figure 7.19: Ease of understanding

✓ **Quality Dimension 18- Depth of knowledge**

Figure 7.20 shows that 89.3% of the respondents agreed that the proposed module had an adequate depth of knowledge. The proposed module had been developed in accordance with Bloom's domains of learning, cognitive, affective and psychomotor. The learning activities were cumulatively structured in order to cover the lower learning levels and the higher learning levels of Bloom's domains.

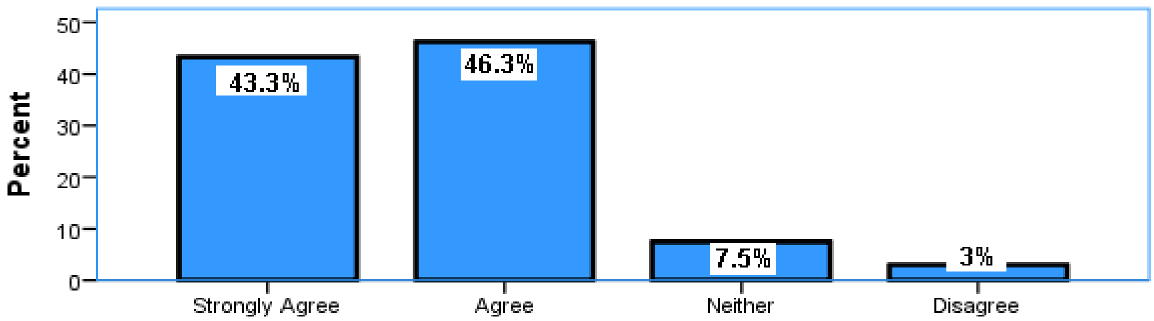

Figure 7.20: Depth of knowledge

- ✓ **Quality Dimension 19- Representational Verifiability**

Figure 7.21 shows that 97% of the respondents agreed that the respondents confirmed that the proposed module was flexible. It was obvious that the learning materials, activities and exercises, could be modified and improved by the teachers who had the authority for online access to the admin page. So, the e-learning package of the proposed SWT module had extra functionality which was not available in the existing engineering courses of the TVE system.

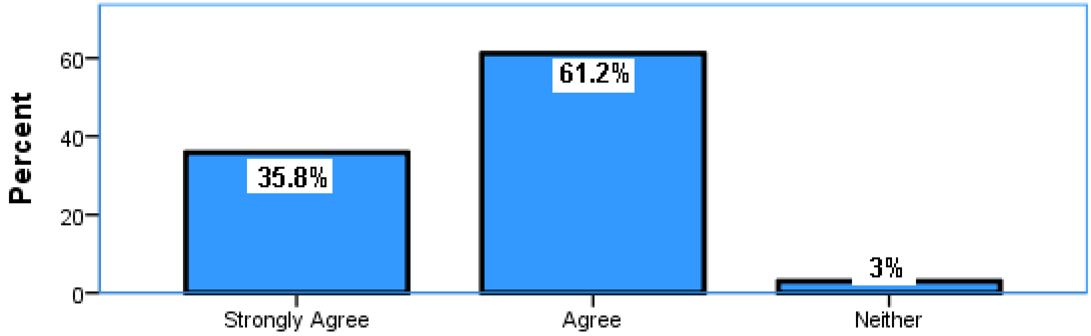

Figure 7.21: Representational Verifiability

- ✓ **Quality Dimension 20- Motivation**

Figure 7.22 shows that 85.1% of the respondents agreed that the proposed module had a variety of learning activities appropriate to different learning styles. The students were encouraged in various learning activities and modes of delivery during the pilot implementation phase. The variety of learning activities in an integrated learning environment motivated TVE students to learn and develop their knowledge and understanding.

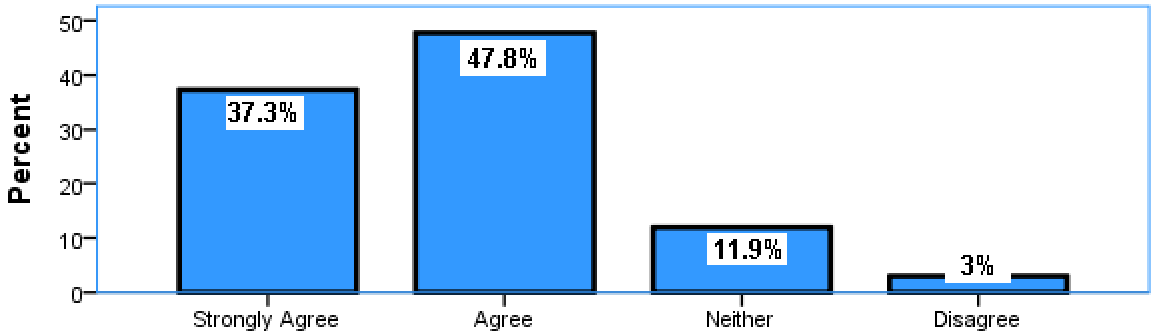

Figure 7.22: Motivation

- ✓ **Quality Dimension 21- Accessibility**

Figure 7.23 shows that 64.2% of the respondents agreed that this module was easy to be accessed online using the website. It was clear that each student had to have a user name and a password to access the website of the proposed module. The learning activities, exercises and assessments were enabled by teachers when required.

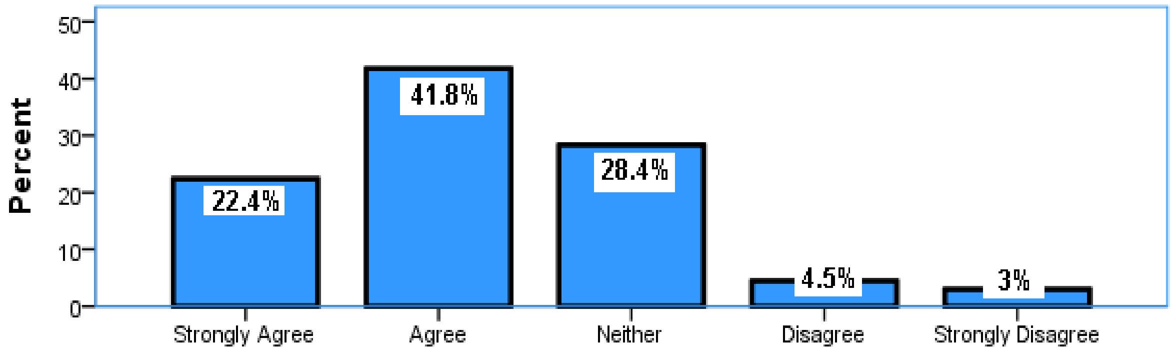

Figure 7.23: Accessibility

- ✓ **Quality Dimension 22- Security**

Figure 7.24 shows that 80.6% of the respondents agreed that the security features were enabled during the pilot implementation phase. The researcher added that students' answers were securely stored in the admin page and only the researcher and the teachers had access to this admin page.

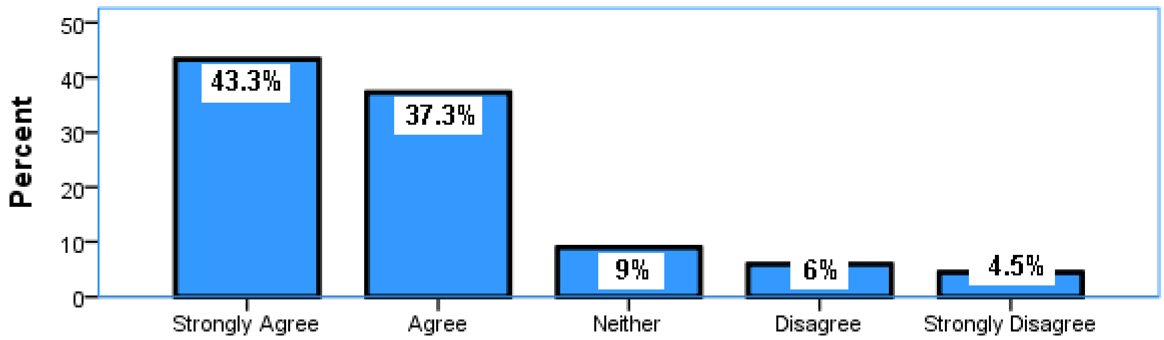

Figure 7.24: Security

- ✓ **Quality Dimension 23- Response time**

Figure 7.25 shows that 97% of the respondents agreed that it was easy to browse and use the web pages of the proposed SWT module. The researcher observed that the students and teachers had no difficulties in browsing, moving from a learning content page to another during the pilot implementation. Also the navigation and internet connections were tested and approved by the IT specialists in the multimedia laboratory.

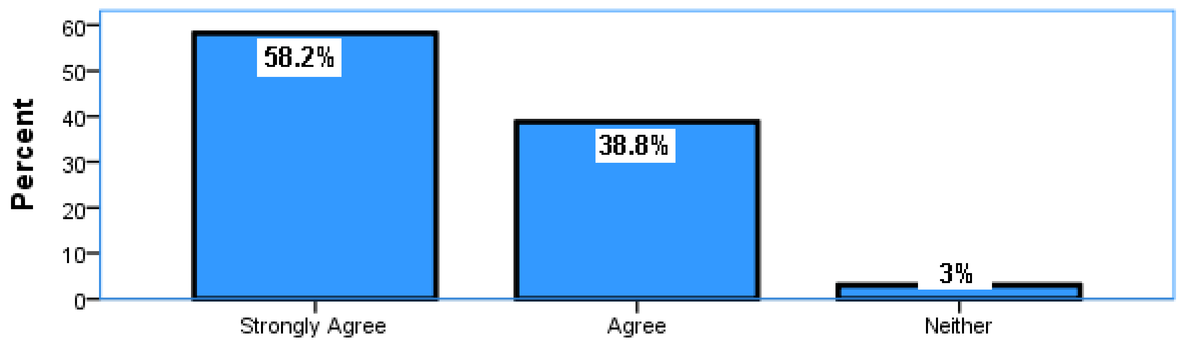

Figure 7.25: Response time

✓ **Quality Dimension 24- Availability**

Figure 7.26 shows that 68.7% of the respondents agreed that the learning content was available as scheduled in the implementation phase. However, 31.3% neither agreed nor disagreed. Better care would be taken in the future to activate the relevant web pages and make the information available as stated in the module's delivery plan.

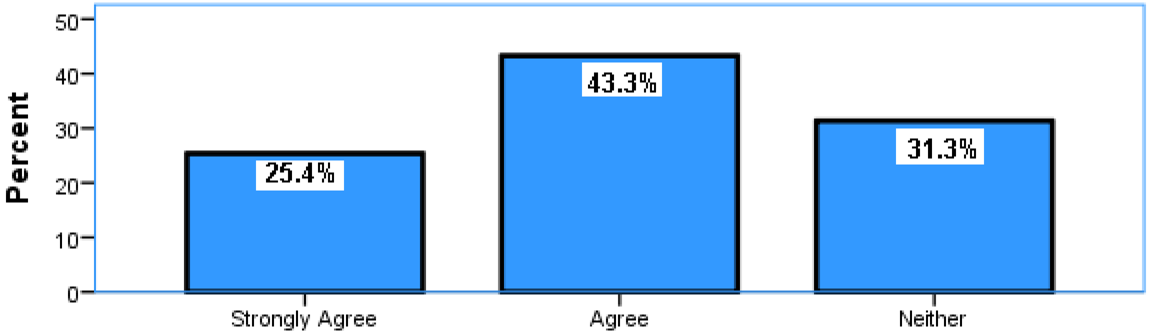

Figure 7.26: Availability

✓ **Quality Dimension 25- Interactivity**

Figure 7.27 shows that 86.6% agreed that different case studies of the proposed module had a variety of interactivity features (such as videos, discussion boards, discussion forum, animations, and instant feedback tests). So the use of technological interactivity features made it easier for the students to share and develop their knowledge, cognitive, affective, psychomotor and technical skills.

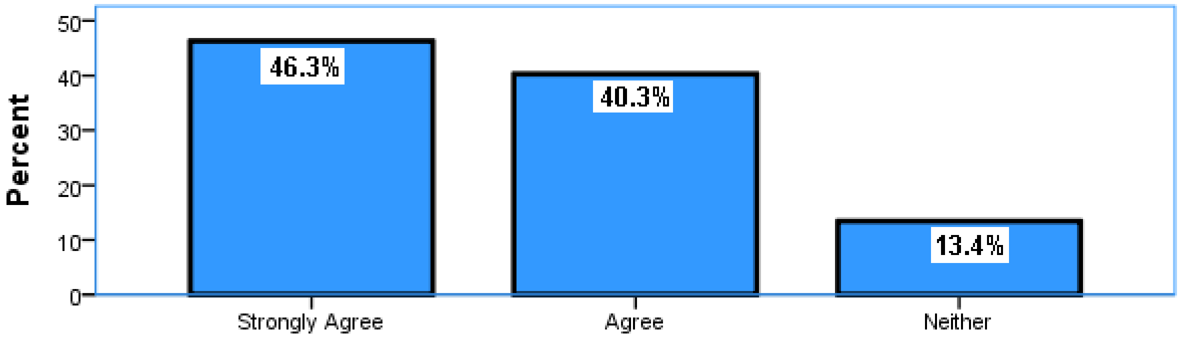

Figure 7.27: Interactivity

7.3.3 Principal Component Analysis

The SPSS was used to analyse the answers for Questionnaire 3 using the principal component analysis technique (a computer test used for statistical analysis which provides exploratory factor analysis). The main reason for implementing factor analysis is to find possible relationships between factors (quality dimensions) that could be helpful in grouping them; therefore, it would be easier for the researcher to develop a framework.

Table 7.2: The factor analysis: descriptives options

Option	Purpose
Statistics	
Univariate descriptive	Generate the means and standard deviations values for the quality dimensions
Correlation Matrix	
Initial solution	Display the original communalities
Eigenvalues	Explain the percentages of variance
Coefficients	Obtain an approximation of the R-matrix from the loadings of the quality dimensions extracted by the analysis
Reproduced option	Obtain communalities and residual differences between the observed and reproduced correlations
KMO	Measure the sampling accuracy

Initially some options to control the factor analysis should be selected from the main menu of the SPSS: Analyse → Dimension Reduction → Factor analysis window which would have the following options:

a) **Descriptives** - help in assessing the data appropriateness for the analysis (see Table 7.2).

b) **Extraction** - the Scree plot option was selected in order to determine the eigenvalues versus component number.

c) **Rotation** - the Varimax procedure was chosen to facilitate interpretation.

d) **Scores** - the factor scores were determined with the regression method.

The outputs from this principal component analysis test are descriptive statistics, correlation matrix, variable communalities, KMO test, Bartlett's test, total variance, scree plot, and rotated component matrix.

Descriptive statistics - were based on the mean and standard deviation for all quality dimensions (factors) related to the answers for Questionnaire 3.

Table 7.3: Descriptive statistics for the variables

No	Dimension	Mean	Std. Deviation	Analysis N
1	Believability	4.13	.571	35
2	Accuracy	4.03	.490	35
3	Objectivity	4.53	.571	35
4	Reputation	4.37	.992	35
5	Consistency	4.12	.640	35
6	Value-added	4.21	1.067	35
7	Relevancy	4.46	.745	35
8	Timeliness	3.61	.778	35
9	Completeness	4.45	.658	35
10	Amount of information	3.64	1.322	35
11	Integration of skills	4.54	.502	35
12	Cultural awareness	4.16	.881	35
13	Personal and social attributes	4.39	.549	35
14	Emotional intelligence	4.00	.718	35
15	Reflection skills	4.37	.546	35
16	Interpretability	4.36	.690	35
17	Ease of understanding	3.73	1.038	35
18	Depth of knowledge	4.30	.739	35
19	Representational Verifiability	4.33	.533	35
20	Motivation	4.19	.764	35
21	Accessibility	3.76	.955	35
22	Security	4.09	1.083	35
23	Response time	4.03	.890	35
24	Availability	3.94	.756	35
25	Interactivity	4.33	.705	35

Table 7.3 presents the mean and standard deviation values for the quality dimensions when a number of 35 respondents were considered. The highest mean values were 4.54 for quality dimension 11 (integration of skills), 4.53 for quality dimension 3 (objectivity). So these are the most important quality dimensions which affected the proposed SWT module. Also the other quality dimensions had mean values above 3 (the mid-point (3) of the 5-point Likert scale), so there were still important dimensions to be considered when analysing the proposed SWT module.

Correlation matrix - was used to identify the correlations between the quality dimensions. Table 7.4 presents an example of correlation values for four quality dimensions. The values above the diagonal could be ignored because they were redundant.

According to Sinn (2011), a high value for the Pearson correlation (r-value) showed the strength and direction (+/-) of the correlation, bigger the value, better the correlation.

The second correlation is called Sig. (2-tailed) representing the p-value (probability to see an r-value of this size just by chance). Number N showed the total number of respondents, in this case 35.

Table 7.4: Correlations between four quality dimensions

		Believability	**Accuracy**	**Objectivity**	**Reputation**
Believability	Pearson Correlation	1	.476**	-.014	.038
	Sig. (2-tailed)		.008	.941	.843
	N	35	35	35	35
Accuracy	Pearson Correlation	.476**	1	-.066	-.113
	Sig. (2-tailed)	.008		.730	.552
	N	35	35	35	35
Objectivity	Pearson Correlation	-.014	-.066	1	.222
	Sig. (2-tailed)	.941	.730		.237
	N	35	35	35	35
Reputation	Pearson Correlation	.038	-.113	.222	1
	Sig. (2-tailed)	.843	.552	.237	
	N	35	35	35	35
****. Correlation is significant at the 0.01 level (2-tailed).**					

Figure 7.28 showed the good correlation between the accuracy dimension and the believability dimension. The example indicated that the p-value is below the 0.01 level; therefore, this gives confidence that there is an actual correlation with the test score.

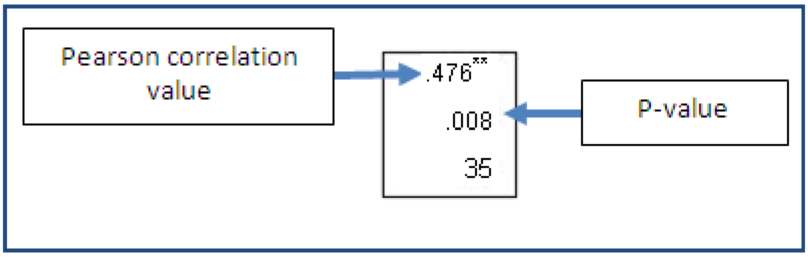

Figure 7.28: An example of good correlation

Figure 7.29 shows another example of the low correlation between the dimensions reputation and accuracy. The r-value is low compared to the other values and the p-value is greater than the level of 0.01. This indicated that there was low correlation between the two dimensions.

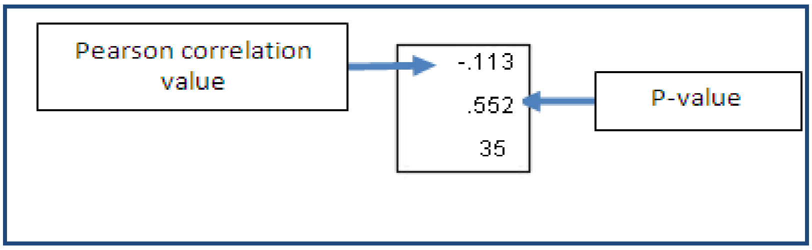

Figure 7.29: An example low correlation

Communalities - indicate the amount of variance in each quality dimension that is accounted for. Table 7.5 shows the communalities before and after applying principal components method of factor extraction. The initial value (before extraction) of the communalities was considered to be 1. The extraction values represent the proportion of each variable's variance that could be explained by the principal components (Kinnear and Gray, 2010). So, after quality dimensions were extracted, the values show how much variance there is in reality. For example, it could be seen that 88.3% of the variance associated with accuracy quality dimension is satisfactory.

Table 7.5: Communalities

No	Dimension	Initial	Extraction
1	Believability	1.000	.729
2	Accuracy	1.000	.836
3	Objectivity	1.000	.903
4	Reputation	1.000	.821
5	Consistency	1.000	.881
6	Value-added	1.000	.849
7	Relevancy	1.000	.852
8	Timeliness	1.000	.790
9	Completeness	1.000	.851
10	Amount of information	1.000	.726
11	Integration of skills	1.000	.847
12	Cultural awareness	1.000	.832
13	Personal and social attributes	1.000	.818
14	Emotional intelligence	1.000	.715
15	Reflection skills	1.000	.747
16	Interpretability	1.000	.840
17	Ease of understanding	1.000	.858
18	Depth of knowledge	1.000	.884
19	Representational Verifiability	1.000	.789
20	Motivation	1.000	.755
21	Accessibility	1.000	.746
22	Security	1.000	.707
23	Response time	1.000	.829
24	Availability	1.000	.875
25	Interactivity	1.000	.750
Extraction Method: Principal Component Analysis.			

Kaiser-Meyer-Olkin (KMO) and Bartlett's Tests – were used for assessing the adequacy of the correlation matrices for factor analysis (see Table 7.6):

The Kaiser-Meyer-Olkin (KMO) test determined whether the collected data are likely to "factor well" based on correlation and partial correlation. The KMO values were recommended to be between 0 and 1 and the reliability of factors was increased when the value was closer to 1. Table 7.6 shows the value of 0.615 which indicated that this analysis had an adequate sample size.

Bartlett's test of sphericity measured if the factor analysis was significant or not by comparing the correlation matrix to an identity matrix (correlation matrix with 1 on the principal diagonal and zeros in all other correlations). For large samples, the Bartlett's test approximates a chi-square distribution assuming that the sample correlation came from a normal population with the independent variables (Knusel, 2008). Table 7.6 showed "an approximate chi-square" 398.912 with an observed significance level which is .000. It was concluded that the strength of the relationship between the quality dimensions were strong and appropriate for factor analysis.

Table 7.6: KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.615
Bartlett's Test of Sphericity	Approx. Chi-Square	398.912
	df	300
	Sig.	.000

Total Variance Explained - Table 7.7 presented the total variance explained output from the principal component analysis extraction method by considering four categories:

a) Component (quality dimension) - this analysis considered 25 quality dimensions.

b) Initial Eigenvalues - were the variances of the principal components. Because the principal components analysis was conducted on the correlation matrix, the variables would be standardised. So the means of the variables would have a variance of 1, and the total variance is equal to the number of variables used in the analysis (in this case 25).

In this analysis, it appeared that the initial eigenvalues incorporated the total variance for each dimension; then the percentage of variance and the cumulative percentage were obtained for each individual component. For example, the first component presented in Table 7.7 had a total variance of 6.809. Then, the factor variance percentage was equal to 27.235% by dividing the total variance by the total number of components, 25.

Based on Kaiser's criterion, the components with eigenvalues less than the value of 1 were excluded. Therefore, the principal component analysis extracted all components with eigenvalues greater than 1 which included eight components and presented cumulative percentage of 69.119%.

c) Extraction sums of squared loadings – were presented in the second part of the table. It contained the same output for initial eigenvalues; however, only the first eight factors were included.

d) Rotation sums of squared loadings- presented the rotated values for the eight components which met the Kaiser's criterion value. Rotation had an effect on optimising the factor structure and the outcome was that the relative importance of the eight components was equalised. For example, it was clear that the first component before rotation had more variance compared to the remaining seven components (27.235% compared to 9.419%, 7.040%, 6.112%, 5.492%, 5.071, 4.685%, and 4.065%). After extraction, the variance compared to the remaining seven components (22.866%, 9.078%, 6.908%, 6.437%, 6.387%, 6.061%, 6.032%, and 5.349%). Therefore, the eight components would be useful for determining the relationships between components and put them into groups.

Table 7.7: Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.809	27.235	27.235	6.809	27.235	27.235	5.716	22.866	22.866
2	2.355	9.419	36.655	2.355	9.419	36.655	2.270	9.078	31.944
3	1.760	7.040	43.694	1.760	7.040	43.694	1.727	6.908	38.852
4	1.528	6.112	49.806	1.528	6.112	49.806	1.609	6.437	45.289
5	1.373	5.492	55.297	1.373	5.492	55.297	1.597	6.387	51.676
6	1.268	5.071	60.369	1.268	5.071	60.369	1.515	6.061	57.737
7	1.171	4.685	65.053	1.171	4.685	65.053	1.508	6.032	63.770
8	1.016	4.065	69.119	1.016	4.065	69.119	1.337	5.349	69.119
9	.925	3.701	72.820						
10	.793	3.173	75.993						
11	.780	3.118	79.111						
12	.727	2.909	82.020						
13	.626	2.505	84.525						
14	.557	2.228	86.753						
15	.540	2.162	88.915						
16	.472	1.887	90.801						
17	.449	1.797	92.599						
18	.391	1.563	94.162						
19	.321	1.284	95.445						
20	.299	1.196	96.641						
21	.259	1.034	97.676						
22	.195	.780	98.456						
23	.157	.628	99.084						
24	.125	.499	99.583						
25	.104	.417	100.000						
Extraction Method: Principal Component Analysis.									

Scree Plot – was presented in Figure 7.30 where the *x*-axis showed the total number of components extracted and the *y*-axis represented the eigenvalues.

It was noticed that the components with an eigenvalue above the value of 1 appeared sharply in the above figure. Then, the curve started to flatten out from component nine where the eigenvalues were below the value of 1. The figure clearly shows that the only retained components should be the ones with eigenvalues greater than 1 (meaning the first eight components).

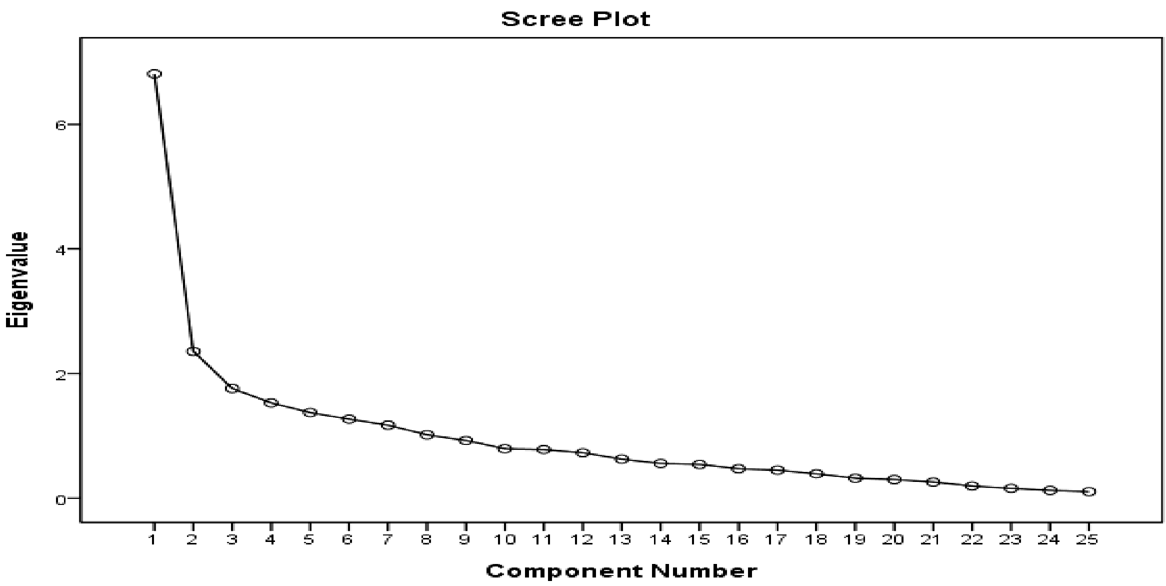

Figure 7.30: The scree plot

Rotated Component Matrix - Table 7.8 shows the rotated components matrix values for each quality dimension. The table assisted in categorising the quality dimensions into eight components through their loading values. In this analysis, the loading values less than 0.5 would not be displayed.

This principal component analysis was significant to calculate the percentage of relative importance of each quality dimensions. The percentage comparison would justify the most important component and the most important quality dimensions.

Using the variables from the rotated component matrix (See Table 7.8) provided by SPSS, the percentage of the relative important of each quality dimension could be calculated by squaring each variable and divided by the sum of all the variables located in the same component.

Percentage of quality dimension relative importance = $\frac{\beta_i^{\,2}}{\sum_i \beta_i^{\,2}}$ (2)

Where, i= 1, 2, 3, 4, 5, etc., β = variables provided by SPSS of the quality dimensions.

The same procedure was followed to calculate the percentage for each component and identify the most important one.

Table 7.8: Rotated component matrix

Quality Dimension	Component							
	1	2	3	4	5	6	7	8
Believability	.716							
Accuracy		.782						
Objectivity							.564	
Reputation	.744							
Consistency	.609							
Value-added	.695							
Relevancy	.779							
Timeliness	.540							
Completeness			.548					
Amount of information	.734							
Integration of skills					.865			
Cultural awareness						.708		
Personal and social attributes					.520			
Emotional intelligence						.513		
Reflection skills								.828
Interpretability			.714					
Ease of understanding				.819				
Depth of knowledge			.752					
Representational Verifiability				.586				
Motivation								.608
Accessibility		.759						
Security		.749						
Response time				.794				
Availability		.776						
Interactivity							.612	
Extraction Method: Principal Component Analysis. **Rotation Method: Varimax with Kaiser Normalization.**								

The factor analysis used the principal components extraction method with Varimax rotation and Kaiser Normalisation. The principal components analysis looked at the total variance. Varimax rotation simplified the columns of the factor matrix by maximising the sum of variances of required loadings of the factor matrix. Also Varimax minimised the number of variables that had a high loading on a factor and might improve interpretability of the factors (Kinnear and Gray, 2010).

Table 7.9 showed that the most important component was number five (14.1%). It comprised two quality dimensions (namely integration of skills, and personal and social attributes).
Also the most important quality dimension was integration of skills (62.5%).

The outputs of the principal components analysis predicted that there were commonalities between the quality dimensions. However, the researcher used his experience for further investigation to propose an evaluation quality framework. In future this framework could be used to measure the effectiveness of the proposed SWT module and other engineering courses in the TVE system.

Table 7.9: Percentage of relative importance

Quality Dimension	Component								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
	12.2%	**12.8%**	**12.3%**	**13.4%**	**14.1%**	**11.6%**	**10%**	**13.6%**	**100%**
Believability	**14.9%**								
Accuracy		**25.5%**							
Objectivity							**48%**		
Reputation	**15.4%**								
Consistency	**12.6%**								
Value-added	**14.4%**								
Relevancy	**16.2%**								
Timeliness	**11.2%**								
Completeness			**27.2%**						
Amount of information	**15.2%**								
Integration of skills					**62.5%**				
Cultural awareness						**58%**			
Personal and social attributes					**37.5%**				
Emotional intelligence						**42%**			
Reflection skills								**57.7%**	
Interpretability			**35.5%**						
Ease of understanding				**37.2%**					
Depth of knowledge			**37.3%**						
Representational Verifiability				**26.6%**					
Motivation								**42.3%**	
Accessibility		**24.8%**							
Security		**24.4%**							
Response time				**36.1%**					
Availability		**25.3%**							
Interactivity							**52%**		
	100%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	

7.3.4 The Evaluation Quality Framework

Figure 7.31 shows the changes made by the researcher as follows:

- Quality dimension 'response time' was moved from Component 4 to Component 2.
- Quality dimension 'interactivity' was moved from Component 7 to Component 2.

The researcher considered that ‘response time’ and ‘interactivity’ had strong links with Component 2 (using technology in teaching). Also the researcher found commonalities between components 3-8 so they considered as belonging to one category (integration and representation of the content).

Component	Quality Dimensions						
1	Believability	Reputation	Consistency	Value-added	Relevancy	Timeliness	Amount of information
2	Accuracy	Accessibility	Security	Availability	Response time	Interactivity	
3	Completeness	Interpretability	Depth of knowledge				
4	Ease of understanding	Representational Verifiability					
5	Integration of skills	Personal and social attributes					
6	Cultural awareness	Emotional intelligence					
7	Objectivity						
8	Reflection skills	Motivation					

Figure 7.31: The division of quality dimensions

Figure 7.32 presented the evaluation quality framework which contained three categories of quality dimensions:

The Evaluation Quality Framework				
Intrinsic and Contextual Category		**Integration and Representation Category**		**Technological Features Category**
Believability	Amount of Information	Completeness	Personal and social attributes	Accuracy
Reputation		Interpretability	Cultural Awareness	Accessibility
Consistency		Depth of Knowledge	Emotional Intelligence	Security
Value-added		Ease of Understanding	Objectivity	Availability
Relevancy		Representational Verifiability	Reflection Skills	Response Time
Timeliness		Integration of skills	Motivation	Interactivity

Figure 7.32: The evaluation quality framework

- **Category 1** – represented the intrinsic and contextual of the content and included the quality dimensions from Component 1 row (see Figure 7.32).
- **Category 2** – represented the integration and representation of the content (including employability skills developed in the content) and contained the quality dimensions from Components 3-8 rows (see Figure 7.32).
- **Category 3** – represented the technological features and included the quality dimensions from Component 2 row (see Figure 7.32).

The intrinsic and contextual category focused on the quality of the content provided in the proposed SWT module from users' preferences and their points of view. This category contained seven quality dimensions:

Believability- it was indicated from the analysed answers of Questionnaire 3 that the majority of respondents agreed that the proposed module had up-to-date pedagogical content. The content was carefully selected in accordance with meeting the learning objectives and the industrial requirements from employability skills.

Reputation- the proposed module had high reputation and could be used as a benchmark for existing engineering courses. However, the objectives of the proposed module might be different from those of other engineering courses in the TVE system; therefore, requirements should be clearly identified before using the proposed SWT module as a benchmark. It should be clear that the content for the proposed module was specifically developed for the transition period from SBL to WBL to enable the students to acquire proficiencies necessary for the work placement.

Consistency- it was indicated from the analysis that the proposed module meets the requirements for employability skills, innovative learning activities for students' different learning preferences, and integration of new technology in the learning environment. Here, it was approved that the proposed module assisted in overcoming the existing problems in the TVE system emphasised in a recent study (Alseddiqi et al., 2010).

Value added- the proposed module added value to the existing TVE system and had overcome some of its existing limitations. In the statistical analysis findings, the respondents agreed that the proposed module used an innovative approach for content development and delivered using the preferred learning styles by TVE students.

Relevancy- Grubb (1995) pointed out that integrating academic and vocational education allowed the learning curriculum to be more relevant to all students. In the proposed module, relevant case studies to real work environment were selected and innovative teaching and learning processes were included. It was observed that the different case studies with varied modes of delivery have met different learning preferences of the students.

Timeliness - It was analysed that half the respondents were uncertain whether the current cooperation with industry would be enough to generate up-to-date learning content. This quality dimension needed extra information from the TVE people to be confirmed. The researcher suggested that more time should be allocated to carry out meetings between the TVE and industrial people to improve the quality of engineering courses.

Amount of information- It was obvious that each case study in the proposed module was related to learning activities that students should understand and demonstrate during the WBL programmes. After the pilot implementation, it was argued that some students had difficulty in completing the learning activities on time. The teachers confirmed that those students with limited ICT skills and less English language ability found it difficult to cope with the amount of information in the proposed module. The researcher clarified that the amount of information in the proposed module was benchmarked against the existing engineering courses; however, other issues were included in the proposed module which increased the load of the amount of information. The proposed module included online learning activities, visits to various sections in the institute, practical applications and a variety of learning styles which require more time than the existing learning courses.

The second category of the evaluation quality framework included the quality dimensions which are related to the integration and representation including quality dimensions related to employability skills. It was indicated from the analysis that these quality dimensions were ranked vital important.

Completeness- the analysis indicated that proposed module included elements for pedagogical content development. They agreed that the proposed module had clear aims, internal objectives (TVE objectives) and external objectives (industrial requirements), learning outlines, and learning outcomes. It was clear that the researcher designed the module's content on the basis of the proposed 2D models for cognitive, affective, and psychomotor skills.

Interpretability- the pedagogical content of the case studies included in the proposed module were clearly organised and structured. The students were interested to study the learning content in a structured manner (i.e. theoretical and practical learning activities). The students tended to understand and share knowledge using the online learning activities and then transfer this knowledge to real work applications in the institute workshop.

Depth of knowledge- it was agreed that the proposed module was designed to correspond to students' ability to learn and practise a range of skills included cognitive, affective, and psychomotor domains skills. Also, various learning levels were classified and applied in the learning content, starting from the simplest learning levels (for basic skills) to higher learning levels (for more specific and complex skills).

Ease of understanding- it was mentioned that the proposed module targeted TVE students in the EEE Year 3 aged 15-18 years. This required a specific writing style to meet the obvious different needs of students. Also, the teachers tended to use easy language to deliver the learning activities to the students. The teachers agreed that the learning case studies of the module had been carefully proposed. In the proposed SWT module, there were skills requirements which were classified such as to cognitive and affective skills; therefore the learning theories which focus on the cognitive structure of knowledge and social context were considered. This would make the learning content more focused and easily understood.

Representational verifiability- The proposed module had some features such as, open-ended learning package allowing TVE teachers to activate, delete, add and modify learning activities using the flexibility of the online learning package. However, the researcher observed that teachers might find difficulties in up-dating and modifying the learning content in future. It was suggested that the workshops should be delivered to maintain and improve the existing case studies of the module. This could also be obtained by choosing the appropriate learning theories to meet the desired outcomes. Seetanah et al. (2010) indicated that suitable learning theories should be selected in developing learning content, taking into account the specific requirements.

Integration of skills- the researcher confirmed that varieties of skills were integrated in the proposed module appropriately. It was observed that the teachers encouraged students in various learning activities to gain different skills. The teachers agreed that the proposed module accommodated skills related to cognitive, affective, and psychomotor. Wagiran (2008) underlined that the integration of employability skills in the learning content produced capable students with the skills and knowledge to perform well during work.

Social and personal attributes- Hamilton and Hamilton (1997) found that industry preferred social and personal competencies to be taught in parallel with practical and technical competencies to TVE students. They believed that social and personal attributes were important and more challenging than teaching only technical competencies. The analysis confirmed that using the discussion boards and forum included in the website of the proposed module tended to develop students' social skills by encouraging students in managing information, communicating with others, working in teams, and providing solutions to problems, management of conflict, and ICT skills.

Cultural awareness- is to meet the modern skills requirements in the workplace; Billet (2008) introduced the concept of cultural awareness in the workplace. The main idea behind this concept was to use knowledge and apply positive behaviour in practical situations. This quality dimension was highly recommended by the industrial companies so, it was considered in the proposed module and included on various learning activities. The researcher observed that the collaborative learning activities integrated in the proposed module assisted in developing students' awareness towards cultural understanding. However, the teachers recommended that more examples should be provided in the learning content specifically for real work applications. They believed that understanding cultural awareness in theoretical learning should be applied in practical learning and in critical thinking.

Emotional intelligence- is another quality dimension which was ranked as highly important. It appeared that emotionally intelligent students could motivate themselves and manage emotions in relationships with others during the process of work (Dacre and Sewel, 2007). The researcher observed that emotional awareness, decision making, initiative, self-regulation, innovation and self-motivation improved TVE students' attitude in the workplace. The analysis indicated that the learning content and the teaching and learning strategy of the proposed module developed students' emotions, helped in adding more value to the students, encouraged to motivate them and built personal relationships with others.

Objectivity- Knight and Burn (2005) and Alkhattabi et al. (2010) underlined that objectivity was recognised as an essential quality dimension for designing learning content. They added that this quality dimension should be as a main pillar in the pedagogical framework for designing learning content. To meet the modern skills requirements of industry, the proposed SWT module case studies were carefully selected and considered various aspects related to employability skills requested by the modern industry. Also, it was indicated from the observation that each case study had its specific objectives. The researcher ensured that the learning objectives met the modern industrial skills needs. The teachers added that the learning objectives were related specifically to cognitive, affective and psychomotor skills needs.

Reflection skills- Mishra et al. (2009) indicated that reflection skills were a vitally important component to develop students' attitude required by modern industry in Bahrain. Later, Alseddiqi and Mishra (2011a) developed an innovative two-dimensional model for affective skills to be used in developing the content of engineering courses. The learning content developed students' reflection skills by different learning activities and exercises through self-development, career development and self-assessment.

Motivation- QAAET (2010) confirmed in the institutions' annual evaluation report that most TVE students did not have the opportunity to participate sufficiently in theoretical modules. They were not motivated or encouraged by TVE teachers to develop various employability skills in SBL modules. The statistical analysis indicated that most of the respondents agreed that the learning content of SWT module had a variety of learning activities which encouraged the students in the process of learning.

The category of technological features included the quality dimensions to evaluate the effectiveness of the website of the proposed SWT module.

Accuracy - it was observed that a thorough approach was used in planning and developing the accurate content for the proposed SWT module. The prototype testing ensured that the technology increased the understanding of the SWT module content and matched the stakeholders' requirements. The prototype development and evaluation were related to the teachers' and students' requirements. For example, the quantitative analysis highlighted the importance of including individual personal needs to improve the overall e-learning experience, which should be reflected positively in students' motivation during the e-learning activities (student interaction is very important) (Salmon, 2000).

Accessibility- is one of the most important technological features that should be presented in e-learning packages, which should contain technical and social perspectives for all users (Tomei, 2008). The prototype design of the proposed module had communication patterns for sophisticated technical support and created open communication channels. Social networking between students and teachers was enabled (for example, online discussion boards were considered as a critical issue in the application and interpretation of the learning activities delivered through the e-learning package). The e-learning package of the proposed SWT had features (such as animations, field visits and videos) which support different learning styles so the students become active participants in the learning activities included in the e-learning package.

Security- the online learning package of the proposed module enabled 'security' functions to protect the content and ensure that only the pilot users could access the module during the implementation. The teachers indicated that more security features should be enabled on the computers when students using the website of the proposed module (i.e. students should not have access to hotmail, facebook, etc.).

Response time- it was noticed that the buttons allowed easy navigation between the web pages of the proposed module. Also the learning package was effective and flexible for Internet browsing.

Interactivity- technological interactivity features were applied in the proposed module and it was confirmed that it would make it easier for the students to share and improve their knowledge, attitude and technical skills. However, some teachers argued that not all the teachers were able to apply interactive technology in the learning process. As Mumcu and Usluel (2010) underlined the teachers' capabilities and experience in the teaching and learning process and their attitude towards technology has a great influence on the expected output when using technology in learning processes.

Availability- it was the teachers' responsibility to activate the related web pages for each study week. The respondents confirmed that the information was available online and permission was given by the teachers to use the learning package during the teaching and learning processes. Also, the teachers had full control on the online web pages and could readily monitor each student's progress and provide the necessary feedback.

7.4 Summary

This chapter discussed the expert evaluation, the pilot implementation, and the user evaluation of the proposed SWT module. The expert evaluation was done by 48 EEE teachers who asked to use the developed e-learning prototype and complete a check list. Then the researcher changed the e-learning package prototype accordingly to the experts' comments. A number of 5 teachers and 30 TVE students from Year 3 of study asked to use the improved version of e-learning package and to complete Questionnaire 3 (user evaluation). The questions were formulated on the basis of extended quality framework developed by the researcher (Alseddiqi and Mishra 2011b; Alseddiqi et al., 2012). The answers were analysed using the descriptive statistics and principal component analysis tests available in the Statistical Package for the Social Sciences (SPSS). The analysis indicated the important quality dimensions and grouped them into new categories. The final section of this chapter discussed the evaluation quality framework proposed by the researcher. In future this framework could be used to measure the effectiveness of the proposed SWT module and other engineering courses in the TVE system.

The researcher has published the following papers which are related to this chapter content:

- Measuring the effectiveness of an online school-to-work transition module, The International Conference on E-learning in the Workplace, June 8^{th}-10^{th}, 2011.

- Development of an Extended Quality Framework for E-learning System Content for Engineering Education Courses, The International Conference on Education Learning in Mobile Age, June 2011. Published in In: Learning with Mobile Technologies, Handheld Devices, and Smart Phones: Innovative Methods. *Hershey, PA, USA: IGI Global. pp. 162-170. ISBN 9781466609365*

- The New School-Based Learning (SBL) to Work-Based Learning (WBL) Transition Module: A Practical Implementation in the Technical and Vocational Education (TVE) System in Bahrain Conference Name – The 25th International Congress on Condition Monitoring and Diagnostics Engineering Education, COMADEM, June 18-20, 2012, Huddersfield, United Kingdom (Accepted to be published in Journal of Physics, Conference Series).

- An Evaluation Quality Framework for Analysing School-Based Learning (SBL) to Work-Based Learning (WBL) Transition Module Conference Name – The 25th International Congress on Condition Monitoring and Diagnostics Engineering Education, COMADEM, June 18-20, 2012, Huddersfield, United Kingdom (Accepted to be published in Journal of Physics, Conference Series).

The next chapter presents the conclusions and suggestions for further research.

Chapter 8- Conclusions and Suggestions for Further Work

8.1. Conclusions

The main aim of the research was to minimise the skills gap between Technical and Vocational Education System (TVE) and modern industrial requirements in the Kingdom of Bahrain. The scope and objectives outlined in section 2.7 have been completed. The intermediate objectives were completed and the following conclusions reached:

- A novel employability skills training model was developed considering the gap between the students' skills acquired during SBL study and the skills required by industrial companies in Bahrain. The gap was determined through quantitative and qualitative analysis of the answers given to Questionnaire 1 by the teachers, industrial supervisors and HR specialists. The proposed employability skills training model (see section 3.5) aimed to satisfy both the TVE (internal) objectives and industrial (external) requirements. The new model was used for the development of SWT module (see section 6.2).
- Two-dimensional (2D) models for cognitive, affective and psychomotor domains were reviewed and developed. The 2D model for cognitive domain was based on Bloom's taxonomy and cognitive processes (see section 4.1). The proposed 2D model for affective domain contained Anderson and Krathwohl taxonomy and the affective dimension from the novel employability skills training model (see section 4.2). The 2D model for psychomotor domain was based on Bloom's taxonomy and the psychomotor dimension derived from Gagné's instructional learning theory (see section 4.3). These models were used for the design of learning activities from SWT module (see section 6.2).
- The correlation between the existing approaches of teaching and learning practised in TVE educational environment with students' learning styles was examined using Questionnaire 2 (see Chapter 5). Examples of modes of delivery to suit different learning styles were presented. The emphasis was on using information technology (i.e. diagrams, charts, videos, animations, hyperlinks) which should enable students to prepare better for the work placement and future careers in industrial environment (see section 5.3).
- A novel SWT module was designed and developed to ensure that TVE students receive the necessary training required by industry before they go in work placement (included in WBL programme). The design was performed by following the user-centered approach (see section 6.1) and was based on the novel employability skills training model and 2D models for cognitive, affective and psychomotor domains.

- The developed SWT module contained five case studies which were related to real work examples. The learning activities challenged the students to recognise, make informed responses, and work comfortably with the diverse requirements of WBL environment.
- A pilot group of 5 teachers and 30 TVE students from Year 3 of study have been asked to use the e-learning package from SWT module and the researcher has written notes (*see Appendix D2*) about his observation of teachers and students during the six weeks of implementation.
- The user evaluation of the proposed e-learning package was done by the students and teachers who completed Questionnaire 3. The answers were analysed using the descriptive statistics and principal component analysis tests available in SPSS. The analysis indicated the important quality dimensions and grouped them into new categories.
- An evaluation quality framework (see section 7.3.4) was proposed by the researcher. In future this framework could be used to measure the effectiveness of the SWT module and other engineering courses in the TVE system.

8.2 Contribution to Knowledge

Several areas have been identified as giving a significant contribution to knowledge under the scope of this investigation:

a) The proposed employability skills training model (see section 3.5) was based on existing ones formulated from the current industrial requirements and researcher's experience. The affective domain skills have been included in the model because modern companies require highly skilled workforce with global perspectives in a cross-cultural capability context. Therefore the SWT module enabled the development of cognitive, affective and psychomotor skills so the TVE students were better equipped when going into work placement. In the long-term, the TVE curriculum including SWT module will create the skilled and educated workforce that will be required to help drive sustainable economic growth.

b) The developed 2D model for affective domain skills (see section 4.2) represented an important contribution to the improvement of the teaching and learning processes of engineering courses from TVE system because the learning activities should be designed in order to enable the students to become more aware about the way they deal with things emotionally (such as feeling, values, appreciation, enthusiasm, motivations, and culture awareness). So the learning should benefit people emotionally, intellectually, socially and economically and have an important contribution to community sustainability.

c) The developed SWT module (see Chapter 6) has minimised the skills gap between SBL and industrial requirements because the students could learn for work (by developing skills for work placement and future employability), about work (acquiring knowledge, understanding and developing attitude of work environment), and through work (by having the chance to learn from practical exercises).

d) The developed SWT module represented an important contribution to the improvement of TVE curriculum because it has provided the students the opportunity to experience the ethos and ambience of the workplace before joining the WBL programme. The theoretical and practical exercises (included in the case studies) enabled the development of students' ability to manage themselves, think and solve problems and work and communicate with others. Also the students were encouraged to reflect (see section 6.2.2) on their own performance, contributions to the group work and accept responsibility of their choices.

e) The proposed evaluation quality framework was designed in order to measure the effectiveness of the new SWT module. The framework was an extended version of existing information quality frameworks with respect to pedagogical and technological contexts. The framework would be useful in determining if the new SWT module contained workplace proficiencies, prepared TVE students for work placement, provided effective teaching and learning methodologies, integrated innovative technology in the process of learning, met modern industrial needs, and offered a cooperative learning environment for TVE students.

The proposed SWT module represented a **major contribution to the improvement of TVE system in Bahrain** because it challenged students and teachers to be capable of recognising, making informed response towards, and working comfortably with the diversity they encounter in WBL environment now and in the future. Moreover, the module influenced and focused students' attention on their future career ambitions and prospects, and made them understand the importance of acquiring a set of portable employability attributes so they were better equipped to carry on the lifelong learning activities.

8.3 Suggestions for Further Work

- The proposed employability skills training model could be extended in order to become applicable to a diverse range of TVE systems from various countries in the Arabian Gulf region (Saudi Arabia, Kuwait, United Arab Emirates, Qatar, and Oman).
- The 2D models can be used to develop the content of other engineering courses in the TVE system in order to include learning activities for developing students cognitive, affective, and psychomotor skills which are required by the industry.
- The SWT module will be improved for the next academic year based on the results of user evaluation, perspectives of TVE policy and industrial needs and expectations.
- The proposed SWT module will be implemented with a larger sample of students from the four TVE institutes in the academic year 2012-2013 for 15 weeks. Appropriate time within the academic semester study plan will be allocated for the proposed module. Further evidence on measuring the effectiveness of the proposed module will be obtained.
- The researcher is willing to measure the effectiveness of the module after the students have completed their WBL programme (work placement). The students will be asked to complete e-portfolios where they should include their results, reflections and impressions about the personal experience during work placement. Also the industrial supervisors could provide feedback about TVE students' performance after they have finished the WBL programme in industry. A questionnaire containing closed and open questions could provide suggestions for further improvements of the proposed SWT module.

The research results presented in this thesis could be used to develop an innovative strategy for identifying modern industrial skills requirements, planning and developing up-to-date learning resources content using innovative technology, implementing the new learning content, and assessing it by using the evaluation quality framework.

A new academic approach for performance improvement in the TVE system in Bahrain could be developed and used as a benchmark for other TVE systems from the Arabian Gulf region because the countries have similar cultures.

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Appendices

Appendix A1

Questionnaire 1 (Employability Skills Questionnaire)

Questionnaire Covering Letter

Dear Sir/Madam

I am pleased to invite you to participate in my study which is being done in the University of Huddersfield, UK.

The aim of this questionnaire is to identify the gap between the students' skills acquired during School-Based Learning (SBL) and the skills required by industrial companies in Bahrain.

It would be grateful, if you could spend few minutes completing this questionnaire in which information received will be critical to the research results and will help evaluating different views and perceptions about employability skills.

I would like to assure you that the information you give will be kept strictly confidential and will be used only for research purposes. For further information, please do not hesitate to contact me

your sincerely

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EMPLOYABILITY SKILL QUESTIONNAIRE

THANK YOU FOR TAKING THE TIME TO COMPLETE THE FOLLOWING QUESTIONNAIRE

PART ONE – PERSONAL DETAILS

1	Gender	Male		Female	
		❑		❑	
2	Age	21-29	30-39	40-49	50-59
		❑	❑	❑	❑
3	Years of experience				
	1-4	5-10	11-20	20+	
	❑	❑	❑	❑	
4	Name of department/division and job title ________________________________				
5	Stakeholder Category				
	Teacher	❑			
	Industrial Supervisor	❑			
	Human Resources Specialists	❑			
	Other	❑ please specify__________________________			

PART TWO – Below is a list of statements for different skills. Please, indicate how much do you agree or disagree with these statements regarding students' abilities towards those skills/elements. Your answer should reflect your first opinion.

Note that,

- For teachers, answers should reflect how they are agreed with the following statements. It should indicate the employability skills acquired by TVE students in SBL from their point of view.
- For Human Resources Specialists respondents, answers should reflect how the following statements from their point of view are important for their industry. It should indicate the required employability skills by the industry.
- For industrial supervisors, answers should reflect how they are agreed with the following statements. It should indicate the employability skills acquired by TVE students in WBL from their point of view.

No	Statement	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1	Students are able to represent written materials for various tasks	❑	❑	❑	❑	❑
2	Students are able to understand how to solve problems	❑	❑	❑	❑	❑
3	Students are able to listen and share ideas with others	❑	❑	❑	❑	❑
4	Students are able to analyse information	❑	❑	❑	❑	❑
5	Students are able to apply Information Technology into practice	❑	❑	❑	❑	❑
6	Students are able to implement practical tasks individually	❑	❑	❑	❑	❑
7	Students are able to participate actively in group's discussion	❑	❑	❑	❑	❑
8	Students are able to test knowledge of mathematics into practice	❑	❑	❑	❑	❑
9	Students are able to demonstrate practical tasks	❑	❑	❑	❑	❑
10	Students are able to apply related knowledge into practice	❑	❑	❑	❑	❑
11	Students are able to quantify engineering applications using ICT	❑	❑	❑	❑	❑
12	Students are able to identify safety standards	❑	❑	❑	❑	❑
13	Students are able to operate machines during practical work	❑	❑	❑	❑	❑
14	Students are able to integrate devices to achieve given practical tasks	❑	❑	❑	❑	❑
15	Students are able to plan engineering projects	❑	❑	❑	❑	❑
16	Students are able to participate with motivation	❑	❑	❑	❑	❑
17	Students are able to exhibit self-confidence	❑	❑	❑	❑	❑
18	Students are committed to continuous improvement	❑	❑	❑	❑	❑
19	Students are able to communicate with people from other cultures	❑	❑	❑	❑	❑
20	Students are able to understand others behaviours	❑	❑	❑	❑	❑
21	Students are able to react in positive manner with others	❑	❑	❑	❑	❑
22	Students are able to list practical terms and tasks	❑	❑	❑	❑	❑
23	Students are able to understand company organisational structure	❑	❑	❑	❑	❑
24	Students are able to acknowledge communication channels	❑	❑	❑	❑	❑
25	Students are able to follow industry rules and regulations	❑	❑	❑	❑	❑
26	Students are able to solve conflicts	❑	❑	❑	❑	❑
27	Students are able to perform well to solve problems	❑	❑	❑	❑	❑
28	Students are able to recognise effective decisions in certain tasks	❑	❑	❑	❑	❑
29	Students are having positive attitude to change	❑	❑	❑	❑	❑
30	Students are able to generate new ideas during practical tasks	❑	❑	❑	❑	❑
31	Students are able to complete practical tasks on time	❑	❑	❑	❑	❑
32	Students are able to listen to different personal views	❑	❑	❑	❑	❑
33	Students are able to follow appropriate procedures in carrying out practical tasks	❑	❑	❑	❑	❑
34	Students are able to use available and new technology in implementing practical tasks	❑	❑	❑	❑	❑
35	Students are able to relate theoretical information to practical tasks	❑	❑	❑	❑	❑
36	Students are able to propose innovative ideas for certain tasks	❑	❑	❑	❑	❑
37	Students are able to manage practical tasks effectively	❑	❑	❑	❑	❑
38	Students are able to perform well in working practically with other students	❑	❑	❑	❑	❑
39	Students are able to maintain good rapport with supervisors and teachers	❑	❑	❑	❑	❑
40	Students are able to participate as leaders in certain tasks	❑	❑	❑	❑	❑
41	Students are able to justify others ideas, participations and opinions	❑	❑	❑	❑	❑

No	Statement	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
42	Students are able to copy the acquired theories to technical issues such as learning about products	❑	❑	❑	❑	❑
43	Students are able to observe the acquired theories to people issues such as interpersonal and cultural aspects of work	❑	❑	❑	❑	❑

PART THREE– ADDITIONAL INFORMATION

Appendix A2

The Descriptive Statistics for Part 2 Questions

Table A2.1: The descriptive statistics of teachers' respondents to Part 2 questions

No.	Question /Statement	Mean	Std. Deviation
Dimension 1 – Cognitive Domain			
Q2	Students are able to understand how to solve problems	3.20	.797
Q4	Students are able to analyse information	1.91	.445
Q5	Students are able to apply Information Technology into practice	2.31	.676
Q8	Students are able to test knowledge of mathematics into practice	2.14	1.033
Q11	Students are able to quantify engineering applications using ICT	3.94	.802
Q12	Students are able to identify safety standards	3.77	.490
Q22	Students are able to list practical terms and tasks	2.57	1.243
Q23	Students are able to understand company organisational structure	3.51	.981
Q25	Students are able to follow industry rules and regulations	3.74	.852
Q26	Students are able to solve conflicts	2.20	.797
Q27	Students are able to perform well to solve problems	2.46	.852
Q28	Students are able to recognise effective decisions in certain tasks	2.03	.891
Q36	Students are able to propose innovative ideas for certain tasks	2.03	1.175
Dimension 2 – Affective Domain			
Q3	Students are able to listen and share ideas with others	3.43	1.170
Q7	Students are able to participate actively in group's discussion	2.54	.950
Q16	Students are able to participate with motivation	2.91	1.222
Q17	Students are able to exhibit self-confidence	2.66	1.211
Q18	Students are committed to continuous improvement	1.97	.857
Q19	Students are able to contribute with people from other cultures	2.69	1.051
Q20	Students are able to understand others behaviours	2.11	.993
Q21	Students are able to react in positive manner with others	4.09	.507
Q24	Students are able to acknowledge communication channels	2.69	1.078
Q29	Students are having positive attitude to change	3.14	1.033
Q32	Students are able to listen to different personal views	1.57	.558
Q39	Students are able to maintain good rapport with supervisors and teachers	2.83	1.403
Q41	Students are able to justify others ideas, participations and opinions	3.83	.664
Dimension 3 – Psychomotor Domain			
Q1	Students are able to represent written materials for various tasks	3.43	1.290
Q6	Students are able to implement practical tasks individually	3.49	.612
Q9	Students are able to demonstrate practical tasks	3.26	1.010
Q10	Students are able to apply related knowledge into practice	3.09	1.121
Q13	Students are able to operate machines during practical work	3.91	.702
Q14	Students are able to integrate devices to achieve given practical tasks	3.49	1.011
Q15	Students are able to plan engineering projects	2.54	1.120
Q30	Students are able to generate new ideas during practical tasks	2.57	1.290
Q31	Students are able to complete practical tasks on time	3.34	1.162
Q33	Students are able to follow appropriate procedures in carrying out practical tasks	2.74	1.358
Q34	Students are able to use available and new technology in implementing practical tasks	3.83	1.098
Q35	Students are able to relate theoretical information to practical tasks	3.14	1.332
Q37	Students are able to manage practical tasks effectively	3.11	1.530
Q38	Students are able to perform well in working practically with other students	3.23	1.114
Q40	Students are able to participate as leaders in certain tasks	2.54	.817
Q42	Students are able to copy the acquired theories to technical issues such as learning about products	3.69	1.022

Q43	Students are able to observe the acquired theories to people issues such as interpersonal and cultural aspects of work	2.86	1.061
Grand Mean		***2.9***	
Scale – 1= Strongly disagree 2 = Disagree 3 = Neither agree nor disagree 4 = Agree 5 = Strongly agree			

Table A2.2: Descriptive statistics of human resources respondents to Part 2 questions

No.	Question /Statement	Mean	Std. Deviation
Dimension 1 – Cognitive Domain			
Q2	Students are able to understand how to solve problems	4.00	.000
Q4	Students are able to analyse information	4.20	.775
Q5	Students are able to apply Information Technology into practice	4.53	.516
Q8	Students are able to test knowledge of mathematics into practice	3.40	.507
Q11	Students are able to quantify engineering applications using ICT	4.40	.507
Q12	Students are able to identify safety standards	4.00	.000
Q22	Students are able to list practical terms and tasks	3.67	.816
Q23	Students are able to understand company organisational structure	3.33	.976
Q25	Students are able to follow industry rules and regulations	3.20	1.207
Q26	Students are able to solve conflicts	2.27	1.335
Q27	Students are able to perform well to solve problems	3.07	1.163
Q28	Students are able to recognise effective decisions in certain tasks	2.13	.640
Q36	Students are able to propose innovative ideas for certain tasks	3.27	.884
Dimension 2 – Affective Domain			
Q3	Students are able to listen and share ideas with others	4.73	.458
Q7	Students are able to participate actively in group's discussion	4.00	.845
Q16	Students are able to participate with motivation	4.13	.352
Q17	Students are able to exhibit self-confidence	5.00	.000
Q18	Students are committed to continuous improvement	5.00	.000
Q19	Students are able to contribute with people from other cultures	4.67	.488
Q20	Students are able to understand others behaviours	4.33	.488
Q21	Students are able to react in positive manner with others	4.00	.000
Q24	Students are able to acknowledge communication channels	4.00	.000
Q29	Students are having positive attitude to change	4.53	.516
Q32	Students are able to listen to different personal views	2.87	.834
Q39	Students are able to maintain good rapport with supervisors and teachers	4.40	.507
Q41	Students are able to justify others ideas, participations and opinions	4.67	.488
Dimension 3 – Psychomotor Domain			
Q1	Students are able to represent written materials for various tasks	4.20	.676
Q6	Students are able to implement practical tasks individually	4.67	.488
Q9	Students are able to demonstrate practical tasks	4.33	.488
Q10	Students are able to apply related knowledge into practice	2.40	.828
Q13	Students are able to operate machines during practical work	3.47	.743
Q14	Students are able to integrate devices to achieve given practical tasks	3.40	1.242
Q15	Students are able to plan engineering projects	3.33	.976
Q30	Students are able to generate new ideas during practical tasks	4.00	.000
Q31	Students are able to complete practical tasks on time	2.40	.737
Q33	Students are able to follow appropriate procedures in carrying out practical tasks	4.27	.594
Q34	Students are able to use available and new technology in implementing practical tasks	4.00	.000
Q35	Students are able to relate theoretical information to practical tasks	2.67	.816
Q37	Students are able to manage practical tasks effectively	3.80	1.014
Q38	Students are able to perform well in working practically with other students	3.53	.516
Q40	Students are able to participate as leaders in certain tasks	4.00	.845
Q42	Students are able to copy the acquired theories to technical issues such as learning	3.33	.976

	about products		
Q43	Students are able to observe the acquired theories to people issues such as interpersonal and cultural aspects of work	4.20	.676
Grand Mean		***3.8***	
Scale – 1= Very important 2 = Important 3 = Don't Know 4 = Slightly important 5 = Not important			

Table A2.3: Descriptive statistics of industrial supervisors to Part 2 questions

No.	Question /Statement	Mean	Std. Deviation
Dimension 1 – Cognitive Domain			
Q2	Students are able to understand how to solve problems	2.47	.990
Q4	Students are able to analyse information	3.40	1.352
Q5	Students are able to apply Information Technology into practice	2.20	.414
Q8	Students are able to test knowledge of mathematics into practice	1.47	.516
Q11	Students are able to quantify engineering applications using ICT	3.73	.704
Q12	Students are able to identify safety standards	4.33	.488
Q22	Students are able to list practical terms and tasks	3.20	1.207
Q23	Students are able to understand company organisational structure	4.13	.352
Q25	Students are able to follow industry rules and regulations	3.87	.352
Q26	Students are able to solve conflicts	1.47	.743
Q27	Students are able to perform well to solve problems	1.00	.000
Q28	Students are able to recognise effective decisions in certain tasks	1.47	.743
Q36	Students are able to propose innovative ideas for certain tasks	2.33	1.291
Dimension 2 – Affective Domain			
Q3	Students are able to listen and share ideas with others	3.27	1.280
Q7	Students are able to participate actively in group's discussion	3.13	1.457
Q16	Students are able to participate with motivation	3.33	.488
Q17	Students are able to exhibit self-confidence	1.60	.507
Q18	Students are committed to continuous improvement	2.60	.632
Q19	Students are able to contribute with people from other cultures	3.67	1.113
Q20	Students are able to understand others behaviours	2.67	1.175
Q21	Students are able to react in positive manner with others	3.60	.828
Q24	Students are able to acknowledge communication channels	4.07	.594
Q29	Students are having positive attitude to change	3.13	1.302
Q32	Students are able to listen to different personal views	1.60	1.298
Q39	Students are able to maintain good rapport with supervisors and teachers	4.27	.458
Q41	Students are able to justify others ideas, participations and opinions	4.20	.414
Dimension 3 – Psychomotor Domain			
Q1	Students are able to represent written materials for various tasks	2.53	1.125
Q6	Students are able to implement practical tasks individually	2.40	1.404
Q9	Students are able to demonstrate practical tasks	2.87	1.187
Q10	Students are able to apply related knowledge into practice	2.93	1.668
Q13	Students are able to operate machines during practical work	3.33	1.175
Q14	Students are able to integrate devices to achieve given practical tasks	3.13	1.125
Q15	Students are able to plan engineering projects	2.93	1.668
Q30	Students are able to generate new ideas during practical tasks	2.13	.834
Q31	Students are able to complete practical tasks on time	3.53	.743
Q33	Students are able to follow appropriate procedures in carrying out practical tasks	1.60	1.056
Q34	Students are able to use available and new technology in implementing practical tasks	2.87	.834
Q35	Students are able to relate theoretical information to practical tasks	2.47	1.642
Q37	Students are able to manage practical tasks effectively	2.07	1.100
Q38	Students are able to perform well in working practically with other students	4.80	.414

Q40	Students are able to participate as leaders in certain tasks	3.20	1.014
Q42	Students are able to copy the acquired theories to technical issues such as learning about products	2.67	.976
Q43	Students are able to observe the acquired theories to people issues such as interpersonal and cultural aspects of work	2.87	.915
Grand Mean		***2.9***	
Scale – 1= Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree			

Appendix B

Example of the Use of the Two-Dimensional Models for Cognitive, Affective and Psychomotor Domains Skills in Developing Learning Activities

For the purpose of demonstration, a learning activity entitled "Select the appropriate components for designing and assembling a battery charger circuit from the customer's requirements" was divided into a number of learning indicators. Table B.1 shows the use of the two-dimensional models with respect to the three domains, cognitive, affective, and psychomotor. The learning activity was divided into a number of specific skills (learning indicators), matching them against Bloom's learning levels (LL).

The students must demonstrate that they can prepare components for assembling the battery charger based on the customer's requirements, negotiate and make decisions with others colleagues, and start the practical work by assembling the components. Specific skills are categorised in accordance with the cognitive psychology of learning, meaning that they must be clearly understood before they are applied in the real workplace. The learning indicators in the two-dimensional models demonstrate:

Learning Indicator 1 – Student listens to various customers' requirements in order to understand their needs. In cognitive skills, the student recalls the data. The knowledge gained from this indicator is factual knowledge. The student receives real information from the customer (affective skills). The new attitude being learnt is the social skills attitude: the student manages information and acknowledges how to access and find new information to meet the requirements. Then, the student observes (psychomotor skills), relying on an external source of information. This learning indicator measures learning level one of Blooms' three domains.

Table B.1: The use of Bloom's taxonomy learning domains in developing learning resources in engineering courses

Learning Activity	**Learning Indicators** Students must demonstrate that they can	**The Two-Dimensional Models for Bloom's Domains of Learning for Cognitive, Affective and Psychomotor Skills**																		
		Cognitive domain (the learning levels being employed in the content)						**Category of knowledge being learnt** (Fact, Concept, Procedure, Strategy)	Affective domain (the learning levels being employed in the content)					**Category of attitude being learnt** (Cultural- Social- Emotional- Reflection)	Psychomotor domain (the learning levels being employed in the content)					**Category of skills condition being learnt** (internal- external)
		LL1	LL2	LL3	LL4	LL5	LL6		LL1	LL2	LL3	LL4	LL5		LL1	LL2	LL3	LL4	LL5	
Select the appropriate components for designing and assembling a battery charger circuit from customer's requirements	Learning Indicator 1	x						**Fact**	x					**Social**	x					**External**
	Learning Indicator 2		x					**Concept**		x				**Social**		x				**External**
	Learning Indicator 3						x	**Strategy**			x			**Social-Emotional**		x				**External**
	Learning Indicator 4			x				**Fact**			x			**Social**		x				**External**
	Learning Indicator 5				x			**Procedure**			x			**Social**			x			**Internal**
	Learning Indicator 6					x		**Strategy**				x		**Social-Emotional**				x		**Internal**
	Learning Indicator 7						x	**Procedure**					x	**Social**				x		**Internal**

Learning Indicator 2 – Student clarifies the list of requirements with the customer. Here the student must understand what the customer needs and then combine the information in a structured process, improving cognitive skills by gaining new conceptual knowledge (cognitive skills, LL2). In affective skills, the student participates actively with the customer and then sets the work objectives (affective skills, LL2). The new attitude being learnt is social skills; the student manages information by participating actively in establishing the customer requirements as instructions. Finally, the student performs the work after agreement on the given instructions (psychomotor skills, LL2).

Learning Indicator 3 – Student justifies the customer's requirement lists. This indicator measures the student's ability to assess the existing situation and review strategic options to meet the customer's needs (cognitive skills, LL6), manage and negotiate the suggested work procedures with other colleagues (affective skills, LL3), and carry out the assembly work for the battery charger from the given practical work instructions and customer requirements (psychomotor skills, LL2).

Learning Indicator 4 – Student compiles a list of components available in store. The student must first discover what components are available in store, together with their specifications in order to have a reliable source of information (cognitive skills, LL3), negotiate and coordinate the available components in team work (affective skills, LL3), and carry out the practical work where components are available, following the given work instructions (psychomotor skills, LL2).

Learning Indicator 5 – Student prepares a request for materials from items in store. Based on the customer specifications, the student has to quantify the battery specification, describing components and quantities, so his knowledge is structured (cognitive skills, LL4). Regarding the affective domain, students should manage the information by negotiating about the components' specifications, agreeing with other colleagues, and filling in the materials request form (LL3). In the psychomotor domain skills, the student completes the forms without assistance, based on pre-knowledge and experience (LL3).

Learning Indicator 6 – Student assesses the requirements from customer's needs and items from store. This indicator measures the student's ability to identify the available components for assembling battery chargers based on the customer's requirements and establishes a list of components that should be procured by the company to complete the assembly process (cognitive skills, LL5). So, the student should use his knowledge to strategically put things systematically and in a particular way. Then the students must formulate a decision-making strategy; they should agree on the list of components to be purchased regularly by the company (affective skills, LL4). Learning level 4 of the psychomotor domain skills measures the student's ability to construct and combine components in the assembly process using previous experience with no instructions from others.

Learning Indicator 7 – Student fills and submits the purchase indent form for additional items. This indicator measures the student's ability to create a new list of additional components for purchasing. The information on component requirements must be collected from various sections of the company (cognitive skills, LL6). Also, this indicator evaluates how students can practise various skills in real-life applications (affective skills, LL5). Learning level 4 of the psychomotor domain skills assesses students' ability to combine the available components with the requested ones to complete the assembly process.

This example indicates that the learning resources were critically developed using the two-dimensional models for cognitive, affective, and psychomotor skills. In addition, it shows that the learning activity was designed to focus on lower and higher learning levels, the complexity of the learning activities increasing by moving from lower to higher learning levels as shown in figure B.1. The learning levels of the three domains are represented along the *y* axis, and the learning indicators along the *x* axis. The example also contains specific skills required by industry, such as the social skills attitude (managing information received from the customer, up to producing the final product).

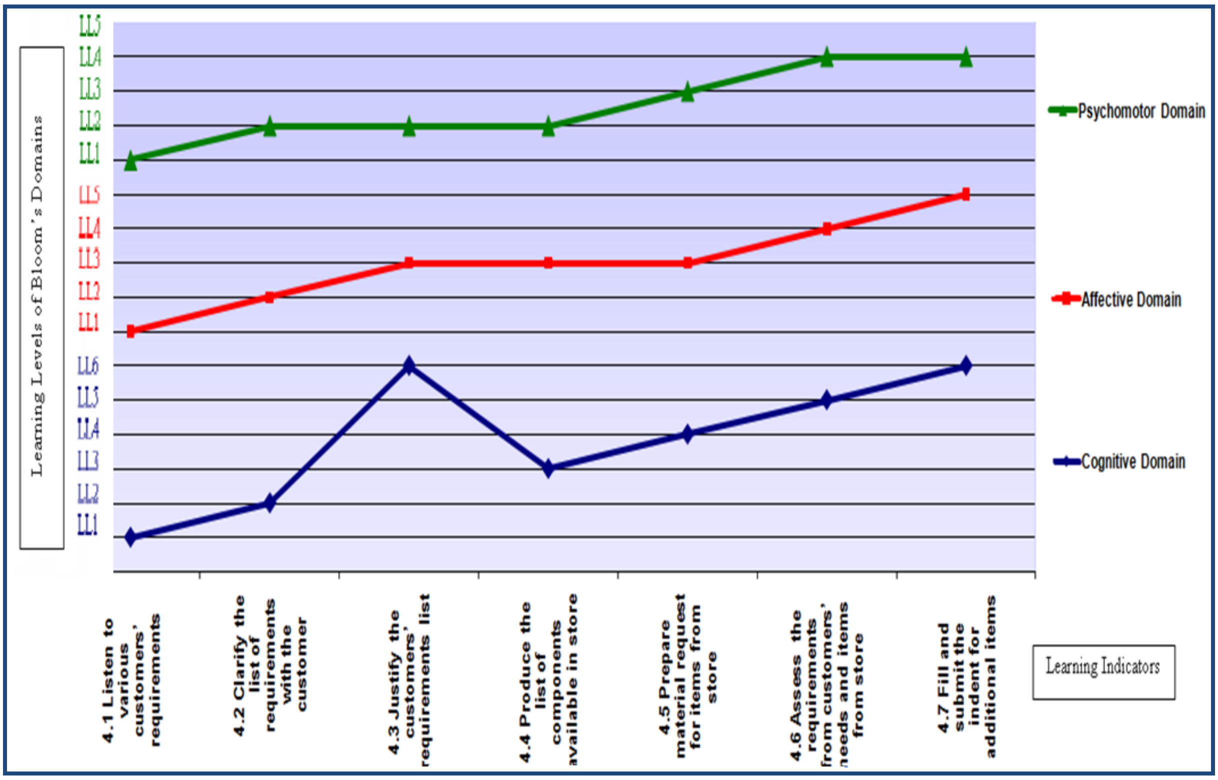

Figure B.1: The learning indicators and Bloom's learning levels

Appendix C1

The Module's Specifications

Module Code:	**SWT**
Module Title:	**SBL-to-WBL TRANSITION**
Institute(s) Involved in Delivery:	Sheikh Khalifa
Name of Course(s):	Year 3 Technical and Applied Routes/Electrical and Electronic Engineering
Module Leader:	Mohamed Alseddiqi
Location:	Multimedia Laboratory- Practical Workshop
Module Type:	Specialised Electrical and Electronic Engineering
Credit Rating:	-
Level:	Secondary
Learning Methods:	Lectures, Online learning, Practical learning, Online exercises, Physical visits, online and face-to-face discussions, Assessments
Pre-requisites:	-
Recommended Prior Study:	-
Co-requisites:	-
Professional Body Requirements:	-
Graded or Non-Graded:	Non-Graded
Barred Combinations:	-

Summary

The main aim of this proposed module is to ensure that TVE students receive the necessary training required by industry and intended to be delivered in Year 3 (Semester 1) prior to the period when students go to work placement.

It contains different case studies for students to observe, apply, discuss, and analyse the various skills required by industry. The case studies are presented with theoretical information for knowledge understanding and attitude acquisition and practical applications for technical and physical skills proficiencies.

The case studies are varied in their modes of delivery and learning styles and are tended to be implemented in an integrated learning environment including a classroom, a multimedia laboratory or require a visit to industry, practical workshops, or other sections in TVE institutes such as career guidance office.

Outline (15 weeks)

- Five case studies that include various technical and work environment competencies.
- Each case study is delivered in an integrated learning environment, and divided into online learning (using the multimedia laboratory) and practical application (using the

practical workshop). In addition, some learning activities and assessments require physical field visits.
- Cognitive skills – based on the employability skills model.
- Psychomotor skills – based on the employability skills model.
- Affective skills – based on the employability skills model.
- Specific job-related skills – based on the employability skills model.
- The learning activities are based on the two-dimensional models for the cognitive, affective and psychomotor domains skills.
- Teaching and learning strategy – based on different modes of delivery with learning styles.
- Student-based learning through team working, problem solving, independent learning activities, and individual and group learning.
- Assessment strategy – based on both computer-based assessment and competency-based assessment approaches to theoretical and practical assessments/exercises.

Learning Outcomes

Knowledge and understanding

On completion of this module, students will be able to:
- Understand the purpose of the SBL-to-WBL transition module.
- Understand the different elements of the work-preparation skills model.
- Demonstrate in-depth understanding of the technical and work environment competencies in the context of the learning case studies.
- Demonstrate in-depth applications from integrating a range of learning activities appropriate to the theoretical parts of the module's learning case studies.
- Appreciate the importance of the integration of innovative learning technology in the delivery of supportive skills for SBL-to-WBL transition as well as technical skills in the learning environment.
- Demonstrate in-depth understanding of the work preparation skills during the work practice in the placement programme.

Attitudes

On completion of this module, students will be able to:
- Feel confident to complete the e-learning package activities effectively in the multimedia laboratory.
- Demonstrate different thinking skills in group discussion activities during interaction with the e-learning package.
- Appreciate the importance of communication skills with colleagues in completing the various activities in the theoretical and practical parts of the learning case studies.
- Appreciate the value of investigating, comparing and evaluating the results from the technical competencies for the SBL-to-WBL transition.

Abilities and skills

On completion of this module, students will be able to:
- Use the available resources and technologies in the electrical and electronic workshop as an effective aid in solving problems and managing the given practical learning case studies.
- Demonstrate personal and technical proficiencies and skills in observing, planning, doing and assessing the practical activities of the module's learning case studies.
- Demonstrate their ability to integrate academic and occupational skills learnt in the e-learning package with technical proficiencies in practical activities in the technical competencies case studies.
- Analyse problems in the given practical learning activities within the technical competencies case studies.
- Create innovative solutions for the given problems in the various practical learning activities.
- Formulate critical thought during the process of providing answers to the case studies' learning activities.

Modes of delivery and learning style

An innovative approach to teaching and learning processes is followed in this module. Students are asked to complete a number of learning activities using different and learning styles with a variety of learning modes (i.e. lectures, online learning materials), and then reflect on their experience and express their feelings.

Assessment strategy

The module's assessments are divided online exercises (computer-based), practical assessment (competency-based), online assessment, and theoretical assessment.

The computer-based is implemented for the theoretical part of the module. The students are assessed by multiple-choice questions and short-answer exercises with instant feedback. Also, some questions require feedback from the teachers. Electronic records are stored for each student and kept as actual evidence of their achievements.

In competency-based assessment, the students should demonstrate a satisfactory level o performance in implementing various practical tasks. The assessments concentrate on the collection of evidence about students' knowledge and performance; and comparison of this evidence with desired learning outcomes. Students either pass or fail (there is a competent and not-competent observation check-list).

The online assessment evaluates students' knowledge and attitude skills including problem-solving, communication, teamwork, information management, and negotiation and evaluation skills. The students must answer the questions and submit electronically. A notification will be give after submission.

The theoretical assessment is based on is provided and answers should be submitted by hand.

Note that, the assessment strategy will be amended to include both formative and summative assessments when the module is fully implemented and integrated in the TVE study plan in the academic year 2012-2013 for Year 3 students.

References

Engineering Maintenance (2010): *Resource Materials: Engineering Maintenance Section*, Student Learning Package Electrical Machines II Theory, Module No: PM313. Technical and Vocational Education: Bahrain, (Un-published).

SWL Logbook (2009): *Students Logbook: GSVEC Resources Materials*. Technical and Vocational Education: Bahrain, (Un-published).

TVE (2010): *GSVEC Resources Materials: Electronic Engineering*. Technical and Vocational Education: Bahrain, (Un-published).

Appendix C2

Descriptions of Case studies 1, 2, and 4

- Case study 1 (Introduction to workplace environment)- introduced the theoretical information for different workplace skills. It provided pre-learning activities for TVE students before they accessed the remaining case studies of the proposed SWT module. It is tended to be delivered in three study weeks. Each study week contains eight lessons which is equivalent to one full day of study.

Online registration is required for the entire students, giving user name and password to access to the website. The teachers control the website, activate case studies when required and mentored students' participation.

The students accessed the case study online with direct instruction from the teacher and supervision in the multimedia laboratory.

Week 1- the teachers should present the theoretical background with direct instruction lectures using technology in multimedia laboratory. Students can access online, watch some pictures with guidelines and teachers should encourage students in face-to-face and online discussions.

Week 2- the teachers should continue giving lectures and important instructions. They should also supervise and monitor students' participations in discussion boards.

Week 3- the same process of teaching and learning should be followed; examples and exercises were designed specifically for improving TVE students' cognitive and affective skills.

On completion of the case study, the students must be able to:

- Demonstrate in-depth understanding of the concept of background to an industry.
- Demonstrate in-depth understanding of the skills required during the WBL programme.
- Understand the health and safety procedures in the workplace.
- Apply the basic health and safety procedures and maintain a safe workplace environment.
- Use and maintain workshop tools and equipment.
- Feel confident of their ability to exercise the learning activities.
- Apply new skills in the WBL programmes.

Learning content design- the case study has included various learning examples and scenarios on employability skills such as cognitive and affective skills. The teacher should discuss the scenarios with the students presenting pictures online and encouraging students to engage socially (such as online and face-to-face discussions). Also, the students are asked to access the case study online and answer some exercises.

Figure C2.1 shows and example from the case study learning activities, entitled background to industry. The *x* axis incorporates the various learning indicators which are measured against the learning levels of Bloom's domains for cognitive (LC) and affective (LA) skills as shown in the *y* axis. The figure shows the first dimension for both the two-dimensional models for cognitive and affective skills, clearly identifying the learning levels employed in the content.

- Students identify the concept of work placement. Here, they receive direct instructions from teachers and are then able to access the online information using their ICT skills. The knowledge gained from this indicator is factual knowledge, so the students are engaged with the teachers by listening to them and reading information and instructions (LC1). The new attitude being developed is the social skills attitude; the students are socially engaged in accessing online information (LA1) by participating in the online discussion boards.

- Students can access various sources of information such as web search engines, the career guidance office to collect information on workplace environments, and strengthen their factual and conceptual knowledge before being involved in more detailed learning activities and case studies (LC1). In affective skills, the students are also engaged socially in accessing online information (LA1) and by participating in the online discussion boards and forum.

- Students must participate actively in discussing the work objectives of their identified workplace/company. They should demonstrate an ability to convert factual knowledge into procedures to be implemented (LC2). The new attitude being developed is social skills; the students become socially connected and manage information by communicating with other students, verbally in the multimedia laboratory or using the discussion forum/boards available online (LA2).

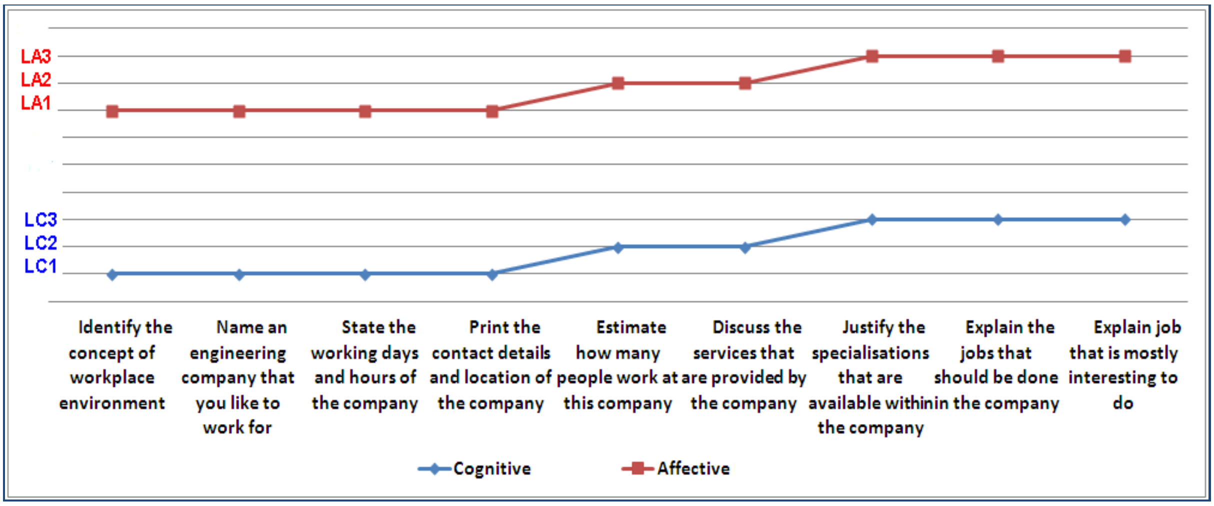

Figure C2.1: The learning levels employed in the content

- Students explain the jobs that could be done in the company. Here they must understand what the company needs and then combine the information in a structured process, improving cognitive skills by gaining new conceptual knowledge and creating new work procedures (LC3). In affective skills, the students can negotiate work procedures with other people and present written materials (LA3).

A health and safety instruction in the workplace is included in this case study. Figure C2.2 shows the learning indicators in the two-dimensional models for cognitive and affective skills.

- The related knowledge and attitude being developed is the health and safety instructions in the workplace, by listening to the teacher's explanation and watching the pictures with instructions available online. Both learning indicators contain the initial information for receiving and understanding the health and safety instructions in the workplace (LC1 and LA1).

- Students understand the health and safety signs and procedures in the workplace. The attitude being developed is managing information and communication skills (LA2). Also, students can construct facts and acquire new knowledge (LC2).

- Students convert the received and understood information into a demonstration, as well as following health and safety instructions. In cognitive skills, the students must use factual knowledge and information in practice (LC3). In affective skills, the students communicate with other people, in face-to-face discussions or online, to negotiate the health and safety instructions and procedures (LA3).

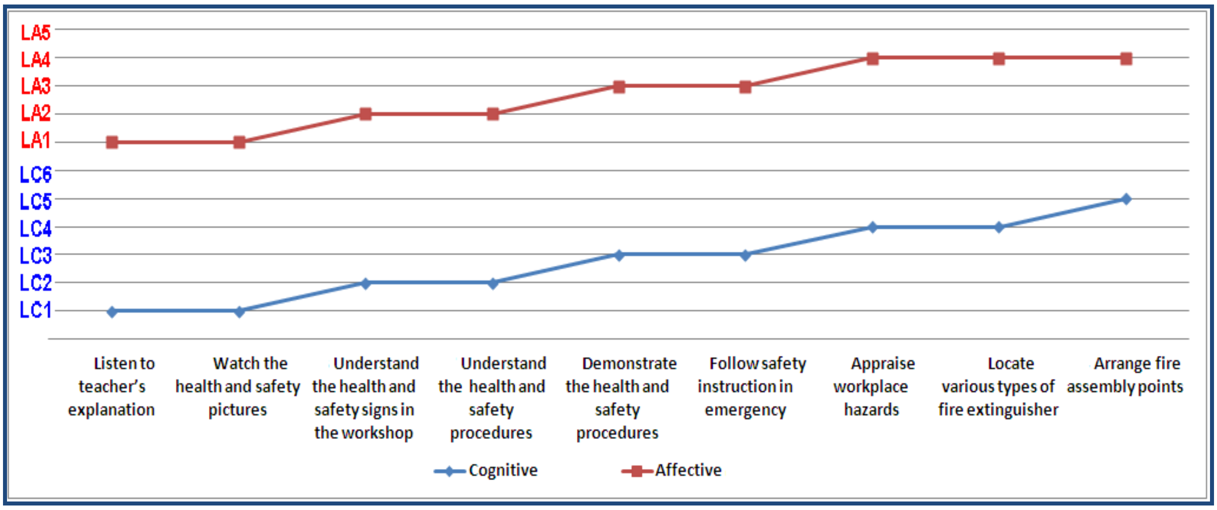

Figure C2.2: The learning levels employed in the content

The above shows that the case study started with the basic information that must be acquired by TVE students before the start of the work placement. In an industrial setup, background information and health and safety procedures are the most important requirements before the start of work. The direct instructions from teachers with the applied technology should focus on and contribute effectively to conveying the information to students clearly and smoothly.

It can be seen that the learning resources were critically developed using the employability skills training model and the two-dimensional models for cognitive and affective domain skills. Specifically, the category of knowledge being learnt is skills for SBL proficiencies. The knowledge is structured for doing something and is related to cognitive skills for improving students' abilities in listening, reading and writing. The attitude being developed from the two-dimensional model is social skills. This category is first related to managing the information facet. The learning activity was designed to include the learning content related to receiving, responding to, and valuing learning levels. In parallel, the social skills attitude which should be learnt in this facet is the ability to acknowledge access and find information, participate actively and follow instructions, and negotiate work procedures with other people. The second facet is communication skills from the social skills attitude. Again, the first three learning levels were employed in the content and should be achieved through receiving information, communicating with other people, negotiating information, and then presenting written materials.

Learning environment- varies from one learning activity to another according to the learning instructions given by the teachers. Therefore, some activities can be delivered in a classroom, a multimedia laboratory or require a visit to industry, practical workshops, or other sections in the institute such as career guidance office.

Modes of delivery and learning styles- are based on direct instruction lectures using technology and accommodate various learning styles such as diverging and assimilating. A good justification would be that both learning styles support students in gathering information as well as building their own knowledge and adding value to their existing backgrounds. The case study also includes other modes such as multiple choice questions, face-to-face and online discussions.

Table C2.1 presents more details of this case study.

Table C2.1: Details of case study 1 (Introduction to Workplace environment)

Learning Activity	Students must demonstrate that they can	Bloom's Learning Domains																							Type of learning environment	Learning Styles				Mode of delivery	Assessment Strategy	
		Category of cognitive process being employed in the content						Category of knowledge being learnt				Category of affective process being employed in the content					Category of attitude being developed	Category of psychomotor process being employed in the content					Category of skills condition being learnt									
		Recall	Understand	Apply	Analyse	Evaluate	Create	Fact	Conceptual	Procedure	Strategy	Receive	Respond	Value	Organise	Act		Observe	Perform	Demonstrate	Construct	Design	Internal	External		Diverging	Assimilating	Converging	Accommodating		Computer-based assessment	Competency-based assessment
1. Background to an industry	1.1 Identify the concept of workplace environment	X						Recall facts				X					Social skills attitude-managing information-accessing to information								Class room	X				Lectures Face -to-face Learning examples	X	
	1.2 Name an engineering company that you like to work for	X						Recall facts				X					Social skills attitude-managing information-accessing to information								Multimedia laboratory Career guidance	X	X			Face -to-face Learning examples Web-search	X	
	1.3 State the working days and hours of the company	X						Identify concepts				X					Social skills attitude-managing information-accessing to information								Multimedia laboratory Career guidance	X	X			Face -to-face Learning examples Web-search	X	
	1.4 Print the contact details and location of the company	X						Identify concepts				X					Social skills attitude-managing information-accessing to information								Multimedia laboratory Career guidance	X	X			Face -to-face Learning examples Web-search	X	
	1.5 Estimate how many people work at this company		X					Understand procedures					X				Social skills attitude –managing information-active participation								Multimedia laboratory Career guidance	X	X			Face -to-face Learning examples Web-search	X	
	1.6 Discuss the services that are provided by the company		X					Understand procedures					X				Social skills attitude –communication skills-Negotiate information								Multimedia laboratory Career guidance	X	X			Face -to-face Learning examples Web-search	X	
	1.7 Justify the specialisations that are available within the company			X				Apply facts and procedures						X			Social skills attitude –communication skills-represent written materials								Multimedia laboratory Career guidance	X	X			Face -to-face Learning examples Web-search	X	

	1.8 Explain the jobs that should be done in the company			X				Apply facts and procedures			X			Social skills attitude –communication skills-represent written materials							Multimedia laboratory Career guidance	X	X			Face -to-face Learning examples Web-search	X	
	1.9 Explain job that is mostly interesting to do			X				Apply facts and procedures			X			Social skills attitude –communication skills-represent written materials							Multimedia laboratory Career guidance	X	X			Face -to-face Learning examples Web-search	X	
2. Health and safety in the workplace	2.1 Listen to teacher's explanation	X						Recall facts	X					Social skills attitude-managing information-receiving information							Class room	X				Face -to-face Learning examples	X	
	2.2 Watch the health and safety pictures	X						Recall facts	X					Social skills attitude-managing information-receiving information							Class room Multimedia laboratory	X				Face -to-face Animations and videos	X	
	2.3 Understand the health and safety signs in the workshop		X					Understand facts		X				Social skills attitude –managing information-active participation							Class room practical workshop	X	X			Learning examples Field visit	X	
	2.4 Understand the health and safety procedures		X					Understand facts		X				Social skills attitude –managing information-active participation							Class room practical workshop	X	X			Learning examples Field visit Manual reading	X	
	2.5 Demonstrate the health and safety procedures			X				Apply facts			X			Social skills attitude –communication skills-represent written materials							Class room practical workshop	X	X			Learning examples Field visit	X	
	2.6 Follow safety instruction in emergency			X				Apply facts and procedures			X			Social skills attitude –communication skills-represent written materials							Class room practical workshop	X	X			Learning examples Field visit	X	
	2.7 Appraise workplace hazards				X			Apply facts and procedures				X		Social skills attitude –managing information-arrange information							Class room practical workshop	X	X			Learning examples Field visit	X	
	2.8 Locate various types of fire extinguisher				X			Apply facts and procedures				X		Social skills attitude –managing information-arrange information							Class room practical workshop	X	X			Learning examples Field visit	X	
	2.9 Arrange fire assembly points					X		Apply facts and procedures				X		Social skills attitude –managing information-arrange information							Class room practical workshop	X	X			Learning examples Field visit	X	
3. The employability skills model	3.1 Access to the online learning resources	X						Recall facts	X					Social skills attitude-managing information- access to information							practical workshop	X	X			Face -to-face Field visit	X	
	3.2 Understand		X					Understand facts		X				Social skills attitude							practical	X	X			Face -to-face	X	

	the explanation from teachers													–manage information-follow instruction							workshop					Field visit		
	3.3 value the model components			X				Apply concepts			X			Social skills attitude –managing information- negotiate information							practical workshop	X	X			Face -to-face Field visit	X	
	3.4 Match the components of the model with their definition				X			Analyse procedures and strategies				X		Social skills attitude –managing information-arrange information							practical workshop	X	X			Face -to-face Field visit	X	
4. Cultural Awareness Attitude in Industry	4.1 Listen to teacher's explanation								X					Cultural awareness attitude- multi-cultural understanding and engagement							Class room	X	X			Face -to-face Learning examples Lectures	X	
	4.2 Watch the cultural awareness pictures								X					Cultural awareness attitude- multi-cultural understanding and engagement							Class room and Multimedia laboratory	X	X			Face -to-face Animations and videos Lectures	X	
	4.3 Discuss the concept of cultural awareness									X				Cultural awareness attitude- cultural engagement in group discussions							Class room and practical workshop	X				Face-to-face Discussion	X	
	4.4 Justify different attributes of cultures with other people										X			Cultural awareness attitude- positive attitude towards multi-cultural people							Class room and practical workshop	X			X	Face-to-face Group learning Dialogues	X	
	4.5 Compare between the culture of other people											X		Cultural awareness attitude- develop good rapport with people from other culture							Class room and practical workshop	X			X	Face-to-face Group learning Dialogues	X	
	4.6 Display relationship with other people from different backgrounds in the workplace												X	Cultural awareness attitude- behave consistently with personal values and solve conflicts							Class room and practical workshop	X			X	Face-to-face Group learning Dialogues	X	
5. Management of information in the workplace	5.1 Listen to different examples provided by the teacher								X					Social skills attitude –managing information – observe how to access to information							Class room	X	X			Face -to-face Learning examples Lectures	X	
	5.2 Watch the								X	X				Social skills attitude							Class room	X	X			Face -to-face	X	

	managing information pictures with instructions													–managing information – observe how to access to information							and Multimedia laboratory					Animations and videos Lectures		
	5.3 Negotiate the concept of managing information									X	X			Social skills attitude –managing information – Participate actively in work instructions							Class room and practical workshop	X	X		X	Face -to-face Learning examples Field visit Dialogue	X	
	5.4 Present examples from previous experience											X	X	Social skills attitude –managing information – arrange and display information in the right order							Class room and practical workshop	X	X		X	Face -to-face Learning examples Field visit Reflective statements	X	
6. Team working	6.1 Listen to teacher's explanation								X					Social skills attitude –working in a team- observe how to become a member of a team							Class room	X	X			Face -to-face Learning examples Lectures	X	
	6.2 Watch the team working pictures with instructions								X					Social skills attitude –working in a team- observe how to become a member of a team							Class room and Multimedia laboratory	X	X			Face -to-face Animations and videos Lectures	X	
	6.3 Interact with other students									X				Social skills attitude –working in a team- participate actively in team's discussion							Class room and practical workshop	X			X	Face -to-face Learning examples	X	
	6.4 Become an active part in team working activities										X			Social skills attitude –working in a team- coordinate the learning activities							Class room and practical workshop	X			X	Face -to-face Learning examples	X	
	6.5 Provide examples of relationship built with other people from team work activities in the workplace											X		Social skills attitude –working in a team- build strong relationship							Class room and practical workshop	X			X	Face -to-face Learning examples	X	
	6.6 Create and maintain effective work relationships												X	Social skills attitude –working in a team- reflect on experience							Class room and practical workshop	X			X	Face -to-face Learning examples	X	
7. Problem solving in the	7.1 Listen to teacher's								X					Social skills attitude -problem solving-							Class room	X	X			Face -to-face	X	

workplace	explanation													observe how to solve a problem												Learning examples Lectures		
	7.2 Watch the problem solving pictures with instructions								X	X				Social skills attitude -problem solving- observe how to solve a problem							Class room and Multimedia laboratory	X	X			Face -to-face Animations and videos Lectures	X	
	7.3 Give examples of problems that may occur during the practical work in the workshop									X	X	X		Social skills attitude -problem solving- Clarify, argue and compare solutions to problems							Class room and practical workshop	X	X			Face -to-face Learning examples Field visit Brainstorming	X	
8. Emotional intelligence attitude in industry	8.1 Listen to teacher's explanation								X					Emotional intelligence attitude- decision making- acknowledge the importance of decision making							Class room	X	X			Face -to-face Learning examples Lectures	X	
	8.2 Watch the pictures with instructions								X					Emotional intelligence attitude- decision making- acknowledge the importance of decision making							Class room and Multimedia laboratory	X	X			Face -to-face Animations and videos Lectures	X	
	8.3 Receive instructions								X					Emotional intelligence attitude- decision making- acknowledge the importance of decision making							Class room and practical workshop	X	X			Face -to-face Learning examples Lectures	X	
	8.4 Respond to instructions									X				Emotional intelligence attitude- decision making-discuss with other people							Class room and practical workshop	X	X			Face -to-face Learning examples Field visit	X	
	8.5 Share instructions with other people										X			Emotional intelligence attitude- decision making- suggest decision making strategy							Class room and practical workshop	X				Face -to-face Learning examples Data collection	X	
	8.6 Develop new instructions for work											X		Emotional intelligence attitude- decision							Class room and practical workshop	X	X			Face -to-face Learning examples	X	

														making- formulate decision making strategy												Field visit		
	8.7 Practice the appropriate instructions												X	Emotional intelligence attitude- decision making- practice in real workplace							Class room and practical workshop	X		X		Face -to-face Learning examples Field visit Decision making	X	
9. Career and personal development	9.1 Listen to how to plan future career								X					Reflection skills attitudes- Personal and career development- listen and plan future career							Class room	X	X			Face -to-face Learning examples Lectures	X	
	9.2 Practice the information that should be attached in the CV									X				Reflection skills attitudes- Personal and career development- set achievable goals							Class room	X	X			Face -to-face Learning examples	X	
	9.3 Understand the purpose and the information that should be included in the CV										X			Reflection skills attitudes- Personal and career development							Class room	X	X			Face -to-face Learning examples	X	
	9.4 Develop CVs											X		Reflection skills attitudes- Personal and career development- discuss with other students							Class room	X	X			Face -to-face Learning examples	X	
	9.5 Evaluate other students CVs												X	Reflection skills attitudes- Personal and career development							Class room	X	X			Face -to-face Learning examples	X	
10. Carry out Self-assessment questionnaire	10.1 Listen to different examples provided by the teacher								X					Reflection skills attitude –self-assessment- acknowledge strengths and weaknesses							Class room	X	X			Face -to-face Learning examples Lectures	X	
	10.2 Understand the concept of self-assessment									X				Reflection skills attitude –self assessment– write portfolio							Class room and practical workshop	X				Reflective statements Learning examples Discussion Dialogue	X	
	10.3 Express the importance of self-assessment										X			Reflection skills attitude –self assessment–							Class room and practical workshop	X				Face -to-face Learning examples	X	

														express personal views												Discussion Dialogue		
	10.4 Complete self-assessment questions										X			Reflection skills attitude –self assessment– write answers							Class room and practical workshop	X			X	Reflective statements Learning examples Discussion Dialogue	X	
	10.5 Discuss answers with other students											X		Reflection skills attitude –self assessment– prioritise answers and opinions							Class room and practical workshop	X			X	Face -to-face Learning examples Discussion Dialogue	X	

- Case study 2 (Study the Elements and Operation of Battery Charger Circuits from Cars) - contained effective online learning activities for understanding and preparing components battery charger circuit and involves collecting information about battery specifications from the customers, and choosing the appropriate components for building the circuit.

Weeks 4 and 5- students should participate in online learning activities, including group discussion, learning examples and learning exercises. It helps students to acquire the necessary information for knowledge understanding and attitude acquisition.

Week 6- students should conduct physical visits to institute workshops and sections to answer the assessments questions. They are tended to collect the necessary information on car batteries and prepare a list of components for assembling a battery charger based on specific requirements from customers.

On completion of the case study, the students will be able to:

- Demonstrate in-depth understanding of the skills required by the industry.
- Feel confident in their ability to exercise the learning activities.
- Demonstrate different thinking skills in group discussion activities during interaction with the e-learning package.
- Appreciate the importance of communication skills in meeting customer requirements.
- Appreciate the importance of suggesting and formulating decisions during the learning process.

Learning content design- The students can access this case study individually and participate with other students using the available online features. They have a specific period of time to complete the assigned learning activities and exercises before being authorised to do the assessments. They should depend entirely on online information, using the available search engine. The case study is an example of student-centred learning which tends to develop students’ lower and higher learning levels from the cognitive and affective skills. Figure C2.3 shows an example of the learning activities employed in the content of this case study.

- Students identify the main parts of a transformer stage (LA1 and LC1).
- Students illustrate the working principles of a transformer (LA2 and LC2).
- Students explain types of transformer (LA2 and LC2).
- Students produce the correct answers in a multiple-choice exercise (LA3 and LC3).
- Students study the types of transformer (LA4 and LC4).
- Students select the appropriate transformer for a given circuit (LA4 and LC4).

- Students conduct the necessary calculations (LA5 and LC5).

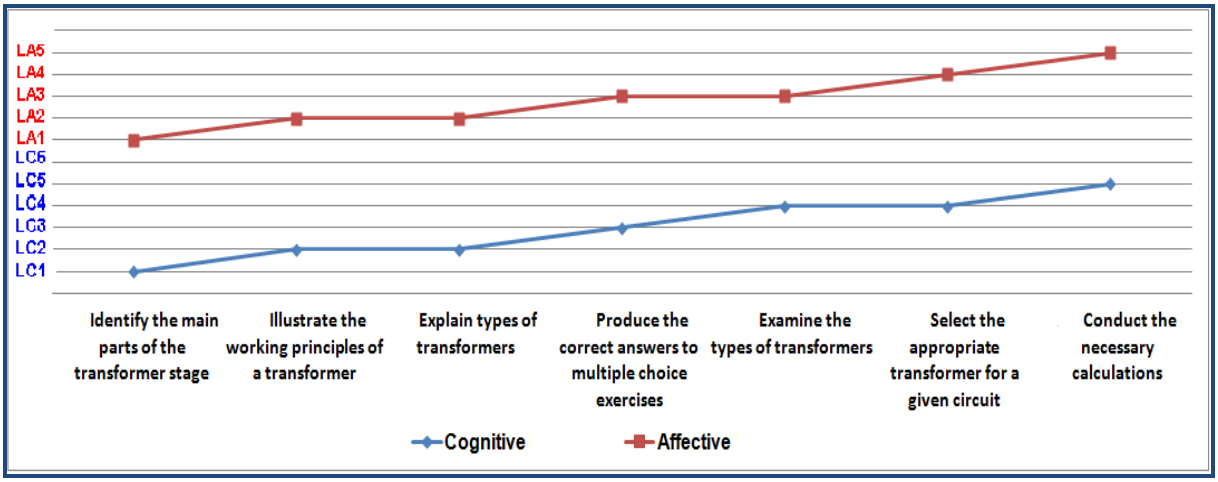

Figure C2.3: The learning levels employed in the content

After completion of the online learning in study week 4 and study week 5, the students are tended to answer three set of assessments based on collecting information from physical visits.

The first asks students to conduct a field visit, to an automotive service centre or the automotive engineering workshop in the TVE institute to collect the necessary information on car batteries. The assessment measures students' competencies and skills gained from the online learning activities. More specifically, the students must take the following steps in order to accomplish the assessment successfully: read the assessment instructions, follow health and safety procedures in the workshop, communicate with other people during the visit, collect battery specifications from the battery maintenance log, discuss the collected information with other students in the group, generate reflective statements on battery applications from the tables produced, produce the required tables with the correct information, and evaluate the collected information. Also, the students can use the Internet search engine and communicate with experts in the field to answer the questions. The assessment allows students to apply their knowledge and attitude in a real work situation.

The second assessment motivates the students; it is a more socially oriented assessment. Here, the students should use their knowledge to socially engage and behave positively in the real work situation. They are asked to prepare a list of components for assembling a battery charger, based on specific requirements from customers. More specifically, the students are expected to listen to various customers' requirements, clarify the list of requirements with the customers, justify the customers' requirements lists, produce the list of components available in store, prepare materials requested for items from store, and assess the requirements from customers' needs and items from store.

In the last assessment, students are assigned to purchase the necessary components for battery chargers with an output voltage of 12V and 5A output current. The questions must be answered individually; however, information can be collected with the help of the shopkeeper and/or Internet search engine. The students must read the assessment instructions carefully, communicate with the shopkeeper, collect the necessary information, discuss the collected information with the shopkeeper, evaluate the collected information, generate written statements, and then complete the assessment.

Learning environment- the case study is delivered and assessed exclusively online, using a multimedia laboratory. Also, students can use their free time to access the learning activities and exercises.

Modes of delivery and learning styles- With online learning, the students can study the case individually and also spend real time online interacting with other students and the teachers, for example using discussion boards and the discussion forum. Principles from behaviourists, psychologists, cognitivists and e-moderating learning modes are included. Salmon (2000) presented a five-stage learning model for an individual's knowledge and experience using online technology. This e-moderating model started with access and motivation, then online socialisation, exchange of information, and finally knowledge construction. In this online case study, teachers should ensure that students are organised in online groups and know how to access the group. Then, the mode of learning concentrates on activities that focus on developing a supportive learning environment for the students to be ready to collaborate online. After that, the students can exchange information by interacting with the learning activities and providing each other with more resources through online discussions. Using the online technology they construct knowledge through collaboratively sharing ideas, and challenging each other by posing problems. The online learning case study is organised to accommodate the application of knowledge and allow students to gain skills and proficiencies in a sophisticated context (Anderson, 2008).Following online learning mode, the learning activities are cognitively and affectively organised to accommodate the diverging and assimilating learning styles. The learning activities were designed to allow students to think critically, understand and produce answers to online exercises and/or participate and share knowledge and experience to achieve the learning activities (see Table C2.2).

Table C2.2: Details of case study 2 (Study The Elements And Operation Of Battery Charger Circuits From Cars)

Learning Activities	Students must demonstrate that they can	Bloom's Learning Domains																							Type of learning environment	Learning Styles				Mode of delivery	Assessment Strategy	
		Category of cognitive process being employed in the content						Category of knowledge being learnt				Category of affective process being employed in the content					Category of attitude being developed	Category of psychomotor process being employed in the content					Category of skills condition being learnt									
		Recall	Understand	Apply	Analyse	Evaluate	Create	Fact	Conceptual	Procedure	Strategy	Receive	Respond	Value	Organise	Act		Observe	Perform	Demonstrate	Construct	Design	Internal	External		Diverging	Assimilating	Converging	Accommodating		Computer-based assessment	Competency-based assessment
1. Background to the theoretical information	1.1 Access to the information available in the e-learning package	X						Recall facts				X					Social skills attitude-managing information-communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation								Multimedia Laboratory	X	X			E-Book Materials	X	
	1.2 Explain the meaning of a battery charger		X					Understand concepts					X				Social skills attitude-managing information-communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation								Multimedia Laboratory	X	X			E-Book Materials	X	
	1.3 Understand the working principles of a battery charger		X					Understand facts					X				Social skills attitude-managing information-communication skills-ICT skills Emotional Intelligence -Initiative-self-motivation								Multimedia Laboratory	X	X			E-Book Materials Short answer exercises	X	

	1.4 Classify different batteries for cars		X					Understand procedures		X				Social skills attitude-managing information-communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Short answer exercises	X	
	1.5 Understand the main three parts of a battery charger circuit		X					Understand facts		X				Social skills attitude – managing information-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Animations Multiple-choice exercises Group learning exercises	X	
	1.6 Follow the proposed theoretical learning sequence			X				Apply Procedures			X			Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Video Discussion Board	X	
2. Transformer stage of the battery charger circuit	2.1 Identify the main parts of the transformer stage	X						Identify facts	X					Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board	X	

	2.2 Illustrate the working principles of a transformer		X					Understand concepts and procedures		X				Social skills – managing information - communication skills-ICT skills Emotional Intelligence initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board Animation	X	
	2.3 Explain types of transformer		X					Understand concepts and procedures		X				Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board Short Answer Exercises	X	
	2.4 Produce the correct answers to multiple choice exercise			X				Apply facts, concepts and procedures			X			Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			Multiple Choice	X	
	2.5 Examine the types of transformer				X			Analyse facts, concepts and procedures			X			Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			Products catalogue reading	X	

	2.6 Select the appropriate transformer for a given circuit				X			Analyse facts, concepts and procedures				X		Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			Theoretical information	X	
	2.7 Conduct the necessary calculations					X		Evaluate facts, concepts and procedures					X	Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			Short Answer Exercise	X	
3. Rectifier stage of the battery charger circuit	3.1 Identify the main stage of a rectifier	X						Recall facts	X					Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			Learning examples	X	
	3.2 Illustrate the working principles a rectifier		X					Understand facts		X				Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board Animation	X	

	3.3 Draw the half and full wave rectifier circuit diagram			X				Apply facts and concepts			X			Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			Short Answer Exercise	X	
	3.4 Collect the necessary information on semi-conductor diodes			X				Apply facts, concepts and procedures			X			Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board Animation	X	
	3.5 Test semi-conductor diodes				X			Analyse facts, concepts and procedures				X		Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Products catalogue reading	X	
	3.6 Participate in discussion board				X			Analyse facts and strategies				X		Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			Discussion Board	X	

	3.7 Produce new theoretical information					X		Evaluate strategies				X		Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board	X	
	3.8 Match the circuit with the components						X	Create procedures and strategies					X	Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board	X	
4. Battery charger output stage	4.1 Identify the main stages of the output circuit	X						Recall facts	X					Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			Learning examples E-learning materials	X	
	4.2 Illustrate the working principles of the output circuit		X					Understand concepts and procedures		X				Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude-Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board Animation	X	

	4.3 Draw the output stage circuit diagram			X				Apply facts and concepts			X			Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude- Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board Short Answer Exercise	X	
	4.5 Prepare and arrange the list of components			X				Apply concepts and procedures			X			Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude- Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board	X	
	4.6 Collect the necessary components information				X			Analyse facts, concepts and procedures				X		Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude- Initiative-self-motivation							Multimedia Laboratory	X	X			E-Book Materials Discussion Board	X	
	4.7 Produce the required answers for the learning exercises					X		Evaluate strategies				X		Social skills attitude – managing information - communication skills-ICT skills Emotional Intelligence Attitude- Initiative-self-motivation							Multimedia Laboratory	X	X			Short Answer Exercise	X	
	4.8 Plan improvement to the circuit design						X	Create strategies					X	Social skills attitude – managing information - communication skills-ICT skills							Multimedia Laboratory	X	X			Discussion Board	X	

- Case study 4 (Design and Implementation of Direct On Line (DOL) Starter Circuits) - the case study aims to design a direct on line starter circuit. It encourages students in groups in practical learning activities. It incorporated technical competencies to develop students' problem solving skills, ability to manage information, participate in group discussions and make decisions.

Week 10- teachers present the background information and explain the practical work procedures using the information available online. Then the teachers divide the students into groups for the practical learning activities. Students then are required to plan the practical work strategy including the preparation of components.

Week 11- students carry out the practical learning activities in groups. They are supervised by the teachers and they can ask questions and have face-to-face discussions.

Week 12- The students are authorised to complete online assessments individually after the completion of the groups' practical learning activities.

On completion of the case study, the students will be able to:

- Understand the working principles of a 3-phase induction motor.
- Collect specific information about electrical switches, contactors, overload relays and fuses using various sources such as manuals, catalogues and the Internet.
- Select suitable components.
- Identify the terminals and test the components, namely:
- Contactors
- Overload relays
- Pushbutton switches
- Fuses.
- Draw the circuit diagram of a DOL circuit.
- Assemble the circuit using the selected components.
- Test the power circuit.
- Test the control circuit.
- Troubleshoot the circuits and suggest solutions.

Learning content design-

Figure C2.4 shows an example of the learning indicators and learning levels employed in the content of a learning activity with various actions. It starts with background information which must be supervised by the teacher. Using the smart board in the multimedia laboratory, the teacher presents warming-up information and the background to the case study; questions can be asked by the teachers and discussed with the students in face-to-face discussions and/or using the online discussion boards. The learning activity ensures that the students interact with the case study content by measuring the following learning indicators: listen to work instructions, follow health and safety procedures, communicate with other people, collect motor specifications from the maintenance log, discuss the collected information with other students in the group, evaluate the collected information with the industrial supervisor, produce the required tables for the database records, and generate reflective statements on various real motor applications. The learning activity prepares students with the required cognitive proficiency (soft skills required by industry) and affective proficiency related to specific skills in both categories (social skills and emotional intelligence attitudes), such as managing information, communication skills, problem solving, and self-motivation. As shown in the figure, both lower and higher learning levels are employed in the content.

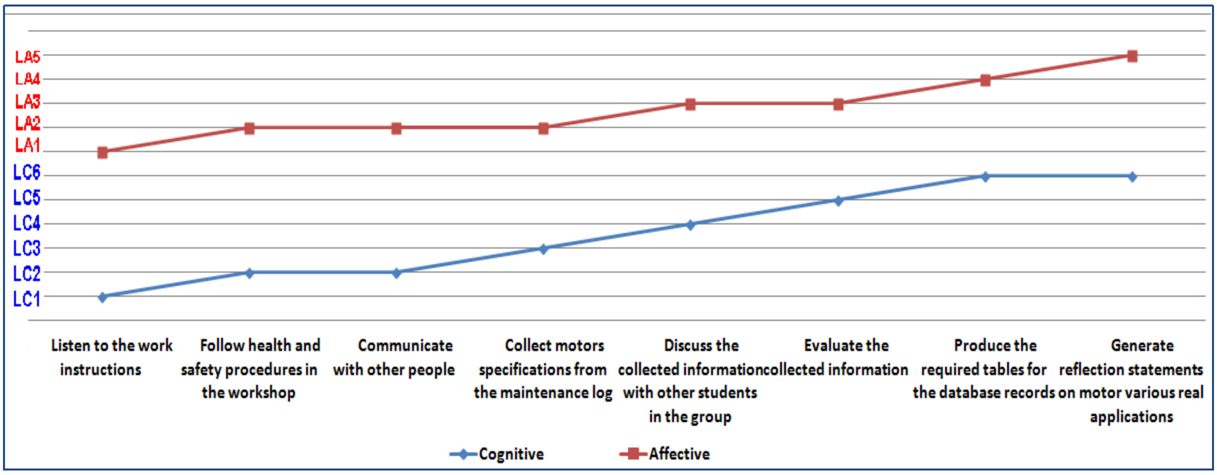

Figure C2.4: The learning levels employed in the content

After understanding the theoretical foundation of the case study, the students convert their cognitive and affective skills into psychomotor skills for technical and physical practical learning abilities related to real work situations. The teacher should divide the students into two teams, each of which liaises with the other to implement practical learning activities two, three, four and five. Each team should gather information from the available theoretical sources and plan and implement the practical part of the learning activities. Each is given an individual block: group one has specified power circuit learning activities and group two control circuit learning activities. The final stage is to connect the two circuits/blocks for generating a 3-phase induction motor. The scope is implementing and improving work preparation skills, as each team has to gather information from the other team to design and develop the part of the practical activities assigned to them. In addition, the learning case study is designed that team work and communication skills can be improved as the teams have to communicate and coordinate in bringing out the final product.

In this case study, the range of skills is expanded further than in the previous case studies. It improves students' cognitive skills such as listening and reading, affective skills such as managing information, problem solving, communication skills, self-motivation, initiative, innovation and decision making; and psychomotor skills such as performing safety standards, demonstrating machine operation and device utilisation. With respect to the specific skills for the affective domain, the learning outcomes will be attained when the students feel confident in accessing information; value their abilities in using online learning systems; appreciate the learning mode of delivery, the variety of sources of information, and learning styles; and then reflect on their understanding in written statements such as asking questions related to personal beliefs and values towards specific attitude skills (Wong, 2006).

Cognitive theorists and psychologists claim that the learning process is reflected in the use of memorising, motivating and thinking. The teacher should start the case study with background information. Knowledge and attitude acquisition can then be assessed against the depth of knowledge gained (Anderson, 2008).

The students are divided into groups to discuss the given information and solve a problem related to situational learning. In this way, the case study is based on problem-based learning supported by the constructivist learning theory (Sherman, 1995). The theory considers the cognitive abilities (knowledge) of the students as a product of each individual's own experience. Fosnot (1996) added that knowledge should be constructed in the mind of the student, not only by being transferred from teacher to student. Here, the knowledge should move from memorising and understanding to applying, analysing, evaluating and creating.

Biggs (1999) underlined that working in teams builds trust between students and teachers, allowing students to construct meaning from the learning process, and teachers to align students' practical learning activities with the learning outcomes. Moreover, the learning mode is controlled by the students and mentored by the teacher; students should take responsibility and make decisions that match their own cognitive and affective state and needs, communicate effectively with others, construct knowledge by formulating ideas into words, and by the interpersonal interactions and responses of others during the process of learning.

Learning environment- the case study is delivered in an integrated learning environment in the institute multimedia laboratory and the practical workshop.

Modes of delivery and learning styles- modes of delivery varied in this case study, such as lectures, face-to-face and online discussions, online exercises and online practical work instructions.

This case study concentrates on the accommodating learning style in the delivery of practical learning activities. According to Richmond and Cummings (2005), the accommodating learning style depends on the students' ability to adapt themselves to accepting the learning situation and existing experience to solve problems and generate a new learning experience. So, this learning style influences students to openly listen to each other, suggest new solutions, and respect others' values, beliefs and behaviours, which reflect positively on improving the specific skills related to their cultural awareness, social skills and emotional intelligence attitudes (Alseddiqi and Mishra, 2011).

Table C2.3 presents more details of this case study.

Table C2.3: Details of case study 4 (Design and Implementation of Direct On Line (DOL) Starter Circuits)

Learning Activities	Students must demonstrate that they can	Bloom's Learning Domains																						Type of learning environment	Learning Styles				Mode of delivery	Assessment Strategy	
		Category of cognitive process being employed in the content						Category of knowledge being learnt				Category of affective process being employed in the content					Category of attitude being developed	Category of psychomotor process being employed in the content					Category of skills condition being learnt									
		Recall	Understand	Apply	Analyse	Evaluate	Create	Fact	Conceptual	Procedure	Strategy	Receive	Respond	Value	Organise	Act		Observe	Perform	Demonstrate	Construct	Design	Internal	External		Diverging	Assimilating	Converging	Accommodating		Computer-based assessment	Competency-based assessment
1. Background to case study	1.1 Listen to the work instructions	X						Recall facts				X					Social skills attitude-managing information Emotional skills attitude – self-motivation								Field visit Practical workshop	X	X			Learning examples Real-life examples		X
	1.2 Follow health and safety procedures in the workshop		X					Understand procedures					X				Social skills attitude-managing information Emotional skills attitude – self-motivation								Field visit Practical workshop	X		X		Learning examples Real-life examples		X
	1.3 Communicate with other people		X					Understand facts and concepts					X				Social skills attitude-communication skills Emotional skills attitude – self-motivation								Field visit Practical workshop	X			X	Learning examples Real-life examples		X
	1.4 Collect motors specifications from the maintenance log			X				Apply facts					X				Social skills attitude-managing information Emotional skills attitude – self-motivation								Field visit Practical workshop	X	X	X		Learning examples Real-life examples Product catalogue		X
	1.5 Discuss the				X			Analyse facts						X			Social skills								Field visit	X			X	Group learning		X

	collected information with other students													attitude- managing information Emotional skills attitude – self-motivation							Practical workshop					examples Real-life examples		
	1.6 Evaluate the collected information					X		Evaluate facts			X			Social skills attitude- managing information- problem solving Emotional skills attitude – self-motivation							Field visit Practical workshop	X	X			Learning examples Real-life examples Reflective statement		X
	1.7 Produce the required tables for the database records						X	Evaluate strategies				X		Social skills attitude- managing information Emotional skills attitude – self-motivation							Field visit Practical workshop		X			Theoretical information		X
	1.8 Generate reflection statements on motor various real applications						X	Evaluate strategies					X	Social skills attitude- managing information Emotional skills attitude – self-motivation							Field visit Practical workshop	X	X			Learning examples Real-life examples Reflective statement		X
2. Draw the circuit diagram of DOL circuit	2.1 Draw the power circuit diagram			X				Apply facts and concepts		X				Social skills attitude- managing information		X				Internal	Practical workshop			X		Practical work implementation		X
	2.2 Draw the control circuit diagram			X				Apply facts and concepts		X				Social skills attitude- managing information		X				Internal	Practical workshop			X		Practical work implementation		X
3. Direct on line starter circuit for a 3 phase induction motor	3.1 Select the suitable components	X						Identify concepts and procedures		X				Social skills attitude- managing information	X					Internal	Practical workshop			X		Practical work implementation		X
	3.2 Prepare a list of components required along with their specifications			X				Apply concepts and procedures			X			Social skills attitude- managing information- managing conflict		X				Internal	Practical workshop		X		X	Products catalogue reading Group practical work		X
	3.3 Discuss the list of selected				X			Analyse facts			X			Social skills attitude-							Field visit	X			X	Group learning examples		X

	components with other colleagues													managing information Emotional skills attitude – self-motivation							Practical workshop					Real-life examples		
4. Test the selected components before use	4.1 Test the contactors terminals				X			Analyse concepts					X	Social skills attitude-managing information-communication skills				X		Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work		X
	4.2 Test the push button switches terminals				X			Analyse concepts					X	Social skills attitude-managing information-communication skills				X		Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work		X
	4.3 Test the overload relays terminals				X			Analyse concepts					X	Social skills attitude-managing information-communication skills				X		Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work		X
	4.4 Test the fuses terminals				X			Analyse concepts					X	Social skills attitude-managing information-communication skills				X		Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work		X
5. Assemble and Test the circuit using the selected components	5.1 Connect the power circuit using the appropriate components						X	Create concepts and procedures					X	Social skills attitude-managing information-communication skills-problem solving Emotional intelligence attitude-initiative-innovative					X	Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work		X
	5.2 Connect the control circuit						X	Create concepts and procedures					X	Social skills attitude-					X	Internal and external	Practical workshop			X	X	Dialogue		X

	using the appropriate components													managing information-communication skills-problem solving Emotional intelligence attitude-initiative-innovative												Practical work implementation Group practical work		
	5.3 Integrate the direct on line starting circuit using the wired power circuit and control circuit						X	Create concepts, procedures and strategies					X	Social skills attitude-managing information-communication skills-problem solving Emotional intelligence attitude-initiative-innovative					X	Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work		X
	5.4 Test the circuit				X			Analyse concepts					X	Social skills attitude-managing information-communication skills				X		Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work		X
	5.5 Connect the direct on line starting power circuit to a 3 phase induction motor						X	Create concepts and procedures					X	Social skills attitude-managing information-communication skills-problem solving Emotional intelligence attitude-initiative-innovative					X	Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work		X
	5.6 Start and stop motor using the on-off push button					X		Evaluate concepts and procedures					X	Social skills attitude-managing information-problem solving				X		Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group work		X
	5.7 Troubleshoot of the circuit					X		Evaluate concepts and procedures					X	Social skills attitude-				X		Internal and external	Practical workshop			X	X	Dialogue		X

														managing information-problem solving												Practical work implementation Group practical work		
	7.8 Plan improvement to the circuit design						X	Create strategies					X	Social skills attitude-managing information-communication skills-problem solving Emotional intelligence attitude-initiative-innovative					X	Internal and external	Practical workshop			X	X	Dialogue Practical work implementation Group practical work Self-assessment		X

Appendix D1

Expert Evaluation Check-List

The information provided in the check-list below is a summary of the experts' comments after they visited the Institute workshop, the multimedia laboratory and used the website (e-learning package) of the proposed SWT module. Then, the information was used to make some changes for improvement on the e-learning package and the learning environment before the pilot implementation.

No.	Criteria	Yes	No	Comments/Evidence
1	**Management of learning environment**			
1.1	***Electrical and Electronic workshop***			
a	The workshop condition has met the health and safety standards	X		This was checked against the Health and Safety Manual of the TVE schools. The researcher reviewed the Health and Safety reports during his visit in March – April 2010
b	The workshop has been prepared for practical work activities	X		The experts checked and ensured that the layout of the workshop has met the needs of the delivering the proposed SWT module (practical learning activities)
c	The workshop has been fully equipped with the required machines, components, equipments, etc.		X	They reported that the stores should have the electronic components necessary for the case studies included in the proposed SWT module
1.2	***Multimedia laboratory***			
a	The laboratory has contained appropriate number of chairs and desks		X	The laboratory should be furnished with at least 32 chairs and desks
b	The laboratory has been equipped with personal computers		X	More computers should be available in the laboratory (32 computers)
c	The computers have been connected to internet and LAN	X		The internet connections were tested by the IT specialists
d	The laboratory has been equipped with OHP, smart board, and white board	X		It was tested and approved
e	The learning software has been installed in the Lab computers (e-book)		X	The computers should be connected to wireless printers and packages such as Adobe Flash Player, Adobe Acrobat, and Real Player. The packages are required for the website of the proposed SWT module. should be installed in the PCs

2	**Management of learning content**			
2.1	***The module's description***			
a	The module's content has contained aims and objectives	X		
b	The module's content has contained the learning outcomes in observable and measurable terms	X		
c	The module's content has contained the teaching and learning methodologies	X		
d	The module's description has contained the assessment strategies	X		
2.2	***The module's learning outcomes***			
a	The learning outcomes have contained the employability skills which are required by the industry	X		
b	The learning outcomes have included new knowledge, skills, and attributes that should be achieved by the students	X		
c	The learning outcomes have included theoretical and practical competencies to industry	X		
2.3	***The learning materials content***			
a	The contents have been organised with an appropriate sequence	X		
b	The content organisation was clear, consistent, and coherent	X		
c	The contents have included elements from the day-to-day working environment	X		
d	The contents have contained industrial setup as well as various elements from the interface of industry and society	X		
e	The contents have included activities and case studies that are related to the learning materials as well as real-life examples	X		
2.4	***The learning theories models***			
a	The learning materials have been developed and based on the three learning taxonomies of Bloom	X		
b	The learning materials have been developed and based on the developed employability skills model	X		
2.5	**The learning activities**			
a	The learning tasks have contained proper workload compared to the number of lessons assigned in the teaching and learning timetable	X		
b	The learning tasks have been formulated with suitable level of knowledge	X		
c	Each case study has been divided into reasonable number of learning activities	X		

d	The learning activities have included new information to students	X		
e	The learning activities have been related to the learning outcomes	X		
f	The learning activities have included open-ended practices/activities	X		
g	The learning activities have included real life applications/situations		X	The learning content should include more examples from real work environment
h	The learning activities have contained texts, images, animations, audios, and videos		X	More pictures and circuit diagrams should be inserted with clear descriptions. Also, more animations could be used (i.e. for logic gate circuits in Case study 3)
i	The learning materials have included problem-based learning activities	X		
2.6	***The assessment strategy***			
a	The assessments have been designed based on the module's learning outcomes	X		
b	The assessment strategy has measured technical competencies and work environment competencies of the developed case studies	X		
c	Summative assessment questions have been included in the module during the practical lessons		X	All assessments are formative. Also a message should appear and inform the user that the answers were submitted successfully at the end of a test
d	The module has assessed students by on-line multiple choice questions enabling quick feedback	X		Instant feedback for students' answers should be given for the multiple-choice questions
3	**Management of website functionality**			
3.1	***Prototype development***			
a	The prototype has been developed on the basis of the stakeholders' requirements	X		
b	The user's requirements have been analysed	X		
c	The learning resources contents and e-learning layout design have been developed and approved	X		
3.2	***Interface and navigation design***			
a	The prototype interface and navigation design has been critically checked against the usability issues	X		
b	The system effectiveness and flexibility in Internet browsing, moving from one activity to another in the e-learning package have been checked	X		Some web pages were not in the correct sequence; therefore, it was re-arranged to the correctly (i.e. the steps of testing the diodes in Case study 2 needed to be organised sequentially)
3.3	***Knowledge analysis and communication***			

a	The prototype design has had communication patterns for sophisticated technical support	X		
b	The prototype design has created open communication channels	X		
c	The prototype design has had social networking between students and teachers in the delivery of the e-learning package	X		
3.4	***Structure and representation***			
a	The layout for activities and assessments within the e-learning package have been designed	X		
b	the learning materials and assessments are converted into e-learning contents	X		It was noticed that some answers were not stored in the users' records available in the admin page

Appendix D2

Notes from Direct Observation during the Pilot Implementation of the E-learning Package included in SWT module

Induction programme delivered to teachers and students (Monday 4 October 2010) – This was the day of the induction programme when I have explained to 30 students and 5 teachers that the learning activities of the case studies included in this e-learning package would be useful for the students because they would be better prepared when they would start the work placement on February 2011.

The students were interested to find out more details about the case studies so I have shown them the web pages with the exercises that they were supposed to solve and the learning materials which could be accessed when looking for effective solutions. My confidence has increased when I saw the high level of interest displayed by the students because I knew that the majority of them would spend a reasonable amount of time in answering the questions from the case studies even though the SWT module did not have a summative assessment.

Also the students liked my explanations when I have shown them that the use of e-learning package would support them in performing authentic tasks so they can define their goals, make individual and group decisions, and evaluate their progress (see Figure D2.1).

The teachers were happy to see a specific module where the learning materials contained theoretical information and practical applications so the students could develop the relevant practical skills, and understand the required skills by the industrial companies which would offer work placement and future employment.

The teachers (see Figure D2.2) were pleased to find out that they would be facilitators when the students are participating in the learning activities included in the case studies. They could choose the modes of delivery and provide guidelines and suggestions for individual students or groups. Also they could offer better support to the students' activity when necessary because they would have the time to walk around the multimedia lab, look over their shoulders and ask about the reasons for various solutions that have been chosen so they could have a better idea about the level of student interaction.

Also the teachers made positive comments about the use of e-learning package because the students could receive immediate feedback about the quality of their work and the teachers could advise them what they could do to make it better. The students working in groups could be fully involved in deciding what needs to be done next, take more responsibility for their learning and participate more in the process of learning.

Figure D2.1: The researcher is observing the students and teacher during the induction programme

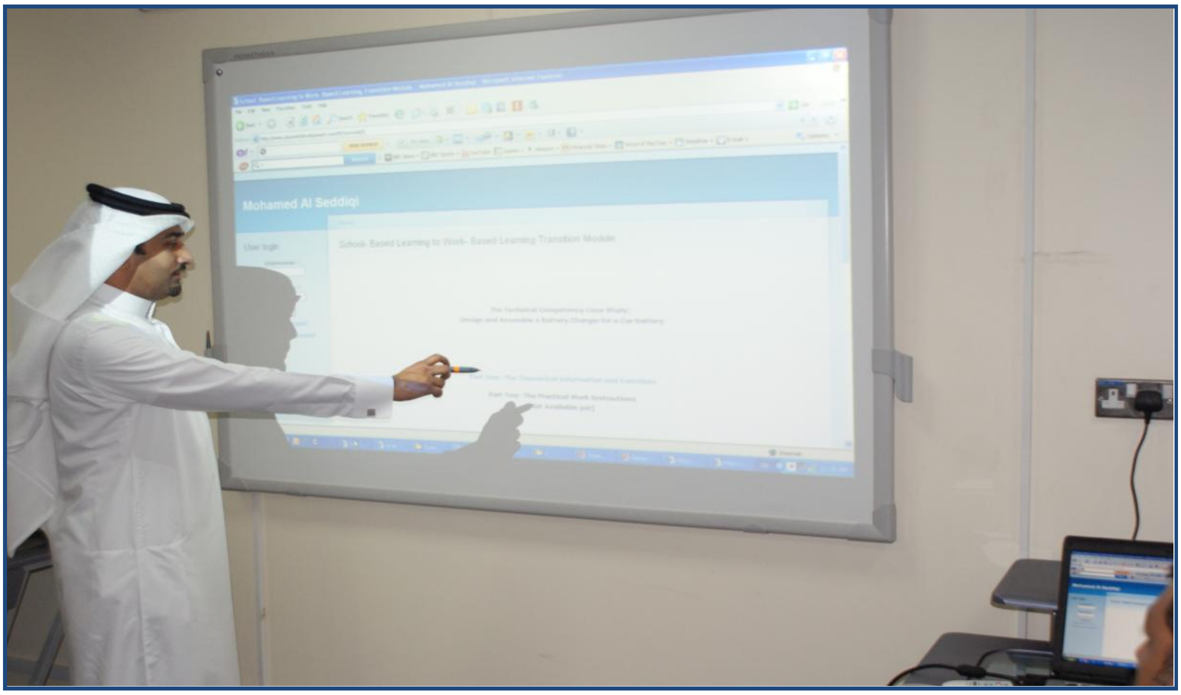

Figure D2.2: The researcher is using the Smart Board to present the e-learning package

Using e-learning package to deliver materials related to Case Study 3 (Tuesday 5 October 2010) – the teacher has used the Smart Board in order to introduce Case Study 3 (Design and Development of Electronic Circuits for Car Parking Counter) to the students. The students seemed more relaxed after the teacher has presented the case study outline, objectives and learning outcomes and gave supplementary details about the online learning materials and electronic components and circuits existing in the Institute workshop.

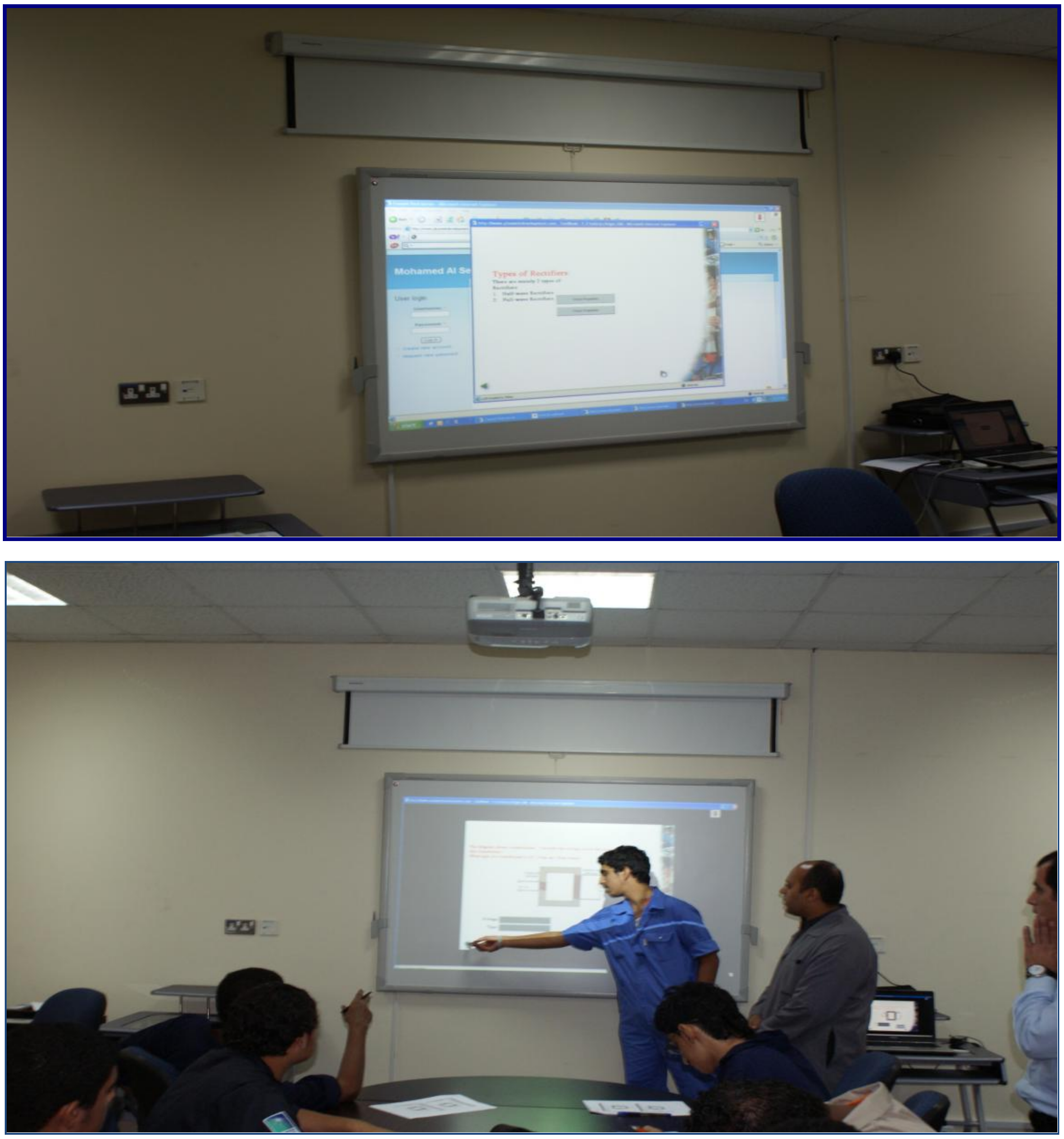

Figure D2.3: The students are using the Smart Board from multimedia laboratory

The students (see Figure D2.3) were enthusiastic when using the Smart Board (interactive whiteboard system) because they could have some useful discussions when working with large amounts of information so it was an active collaboration between all the students from the group. They liked to use the Active Pen because they could move and manipulate objects on the whiteboard (working as a computer mouse) as well as highlight and annotate text on the whiteboard (working as a digital pen). The teachers have enjoyed using the Playback option because they could hand write the walk through a math problem and the notes could be saved for future review by both the students and the teacher.

The students have accessed the online learning materials for several hours and then I have asked to comment on this novel way of delivering a session. It was obvious that the use of technology in the teaching and learning processes has met better the obvious needs of various types of learners. Several students liked the static websites, while others preferred the links to other websites because they felt encouraged to be interactive and independent. Some students liked video clips while others preferred Power point slides or other graphic illustrations.

I have observed that this innovative approach to teaching and learning encouraged the students to work collaboratively and contribute in a positive and productive way to the process of finding out effective solutions for their group (see Figure D2.4). Also the students had better social interaction when they felt safe and comfortable enough to ask questions and share concerns because the teachers acted as facilitators.

Figure D2.4: Students are accessing the online learning package in the multimedia laboratory while others are working in groups in the Institute workshop

Practical assessment related to Case Study 3 (Monday 11 October 2010) – it was the first day when the teacher has presented the details of the practical assessment related to Case Study 3 (Design and Development of Electronic Circuits for Car Parking Counter) to the students. The teacher has presented the video of practical work guidelines which has been included in the e-learning package. The students have asked questions after watching the video so it was obvious that the video was useful in providing them an initial idea about the work placement environment and what knowledge, skills and attitudes were required by industry. I have talked to the teacher during the break and he was satisfied of being able to show the students a video about real work environment because they would feel at ease when doing the practical work in the Institute workshop and work placement.

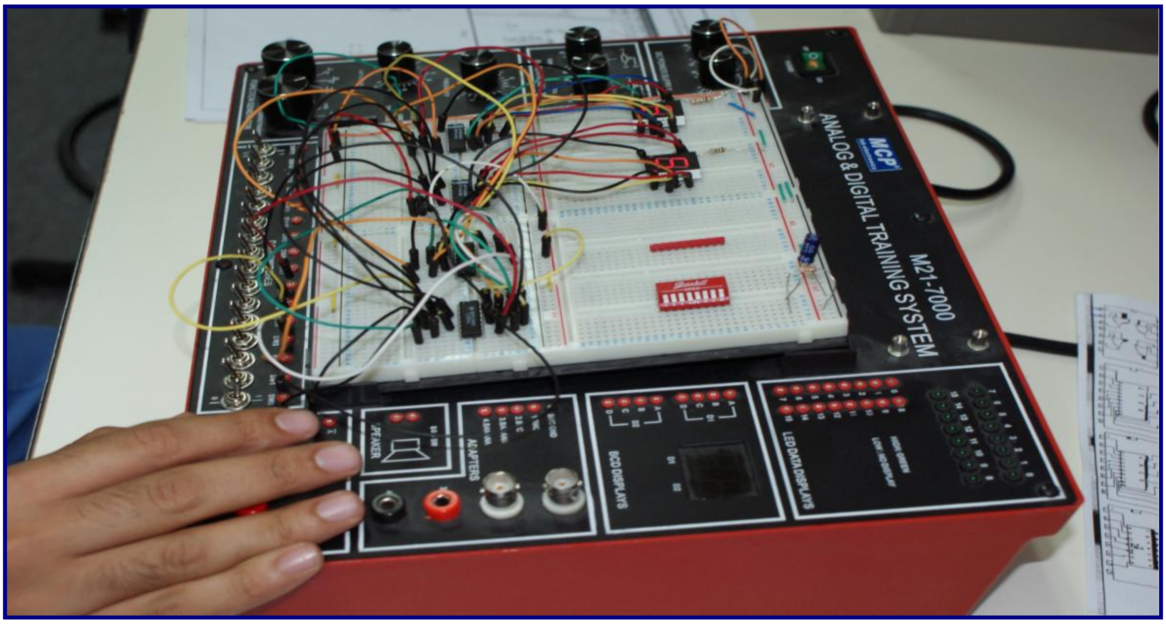

Figure D2.5: Practical assessments in the Institute workshop

Then the students went to the Institute workshop and asked to build individually circuits for car parking counter (see Figure D2.5). The practical assessment motivated students to use their knowledge and perform in a practical work environment. They were asked to prepare a list of components for assembling car parking counter circuits, based on specific given requirements. I have talked to the students after they have finished their practical assessment and they have underlined that it was very useful to watch the video before they came to the Institute workshop to prepare their practical assignments.

Theoretical and online assessment related to Case Study 3 (Monday 25 October 2010) – I have observed that the teachers had given the students the authority to access the case study online assessment and answer the questions individually. My comments were that they had a specific period of time to complete the assigned questions in the online assessment. The students were encouraged to answer the questions and they also could demonstrate their proficiency in using online materials to solve the questions.

Figure D2.6. Online assessment in the multimedia laboratory

After that the students were asked to answer the questions of the online and handwritten assessments (see Figures D2.6 and D2.7). I have noticed that some students had difficulties in doing two assessments with different formats in the same day. Also, the teachers had to clearly identify the purpose of each assessment and arrange the time efficiently to complete both assessments on the same day. This assessment tended to improve students' thinking skills, creativity and problem solving capability.

Figure D2.7. Hand-written assessment in the multimedia laboratory

Appendix D3

Questionnaire 3 (Users' View on the Effectiveness of the Proposed SWT Module)

Dear User

It would be grateful, if you could spend few minutes completing this on-line questionnaire in which information received will be critical to the research results and will help in evaluating different views and perceptions about the effectiveness of the e-learning package included in the SWT module.

I would like to assure you that the information you give will be kept strictly confidential and will be used only for research purposes.

Users' View on the Effectiveness of the Proposed SWT Module

		Strongly Agree	**Agree**	**Neither**	**Disagree**	**Strongly Disagree**
1	The learning package provides updated information to meet modern industrial needs					
2	The learning package contains scientific and accurate content					
3	The learning package has impartial learning case studies					
4	The learning package can be used as a benchmark for producing future engineering learning packages					
5	The learning package has consistent information					
6	The learning package adds value to the engineering education courses					
7	The learning package considers relevant information to modern industrial needs					
8	The learning package incorporates up-to-date learning case studies					
9	The learning package has applicable information to meet both the TVE and the industrial objectives					
10	The learning package includes appropriate amount of information in a structured manner					
11	The learning package provides clear instructions for practical applications					
12	The learning package conveys personal beliefs					

13	The learning package allows the students to engage with others					
14	The learning package allows students to react with others					
15	The learning package allows students to assess themselves					
16	The learning package has clear and appropriate language, structure, and instructions					
17	The learning package information is easily understood					
18	The learning package has different learning activities					
19	The learning package has flexibility so information can be modified					
20	The learning package has different learning activities with various modes of delivery					
21	The learning package can be easily accessed on-line					
22	The access security features are enabled to protect the content of the e-learning package					
23	The web pages are effectively responding; flexibility in browsing and moving from one learning activity to next					
24	The information is available and can be accessed as scheduled in the module's delivery plan					
25	The web pages have different interactivity features such as videos, animations, and feedback system for corrections and extra information					