Teachers' and Students' Attitudes Towards Traditional and Computer Assisted Blended Teaching and Learning Processes in Mechanical Engineering Subjects Area.

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Abstract

The effectiveness of traditional teaching-learning process in Computer Aided Design (CAD), Computer Aided Manufacturing CAM and Computer Numerical control CNC (CAD-CAM-CNC) module has been evaluated against recently developed two blended teaching learning models. The blended learning systems have been developed by integrating computer assisted instructions with the traditional teaching learning system. This study in particular reports teachers' and students' views about various facets of teaching and learning process under different modes. It has been see that blended learning modes find better acceptance amongst teachers and students as compared to traditional teaching mode.

Introduction

The teaching and learning processes used in engineering education and the resource requirements are rapidly changing. Various learning environments are being developed to increase the teaching and learning effectiveness. These developments go through a period of trial and error before taking firm roots in the teaching and learning process. The CAD-CAM-CNC module is common for Automotive, Welding, Manufacturing, Carpentry and Refrigeration students within technical and vocation education system in Bahrain. It is an important module in mechanical engineering subject area and has four typical stages during one academic year teaching programme (see Figure 1).

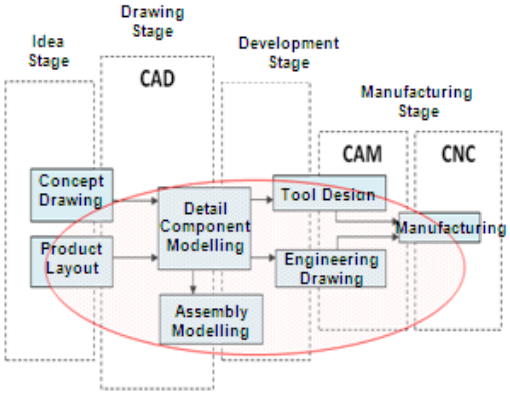

Figure 1 – The stages of CAD-CAM-CNC module

In this module the students are required to manufacture physical 3D components by understanding the concepts linked to product design, engineering drawing and product layout [1]. A learner must be able to develop an product idea and take it to the product manufacture stage. Hence teaching and learning (T & L) methodology for tis module should have all the embedded knowledge transfer elements required for the students. The learning outcomes for this module can be classified in two categories as shown in table 1

Table 1 - learning outcomes

General engineering outcomes - The student will be able**:**	**Specific outcomes required in the manufacturing process:** The student will have the ability:
To design and conduct experiments; identify and solve engineering problems	To design the part geometry, create engineering drawing for parts and assemblies.
To design a system, component or process to meet desired needs	To enter the cutting parameters and generate tool paths for different layers.
To use the techniques, skills and tools for modern engineering	To load the machining program and verify it.
To design, analyze, implement, and manage effective production and service systems	To set up the machine for manufacturing process.
To integrate processes involving people, material, equipment and information	

The above learning outcomes need to be delivered to the students through a well design teaching and learning methodology. Traditionally a combination of lectures, tutorials and laboratory classes are used to manage the teaching and learning process. Recently the visual and simulation capabilities of computers and inherent flexibility in their use are being recognised as an important tool in improving effectiveness in engineering education. The computer technology plays a great role in improving the T & L methodology in mechanical engineering subject area [2, 3, 4]. The computer as medium of instruction can be used to manipulate and combine CAD and CAM operations. Visual effects offered by computers contribute to the easy design of

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mechanical components and assemblies [5, 6, 7, 8]. The author has decided to investigate the impact of Computer Assisted Learning (CAL) on the effectiveness of educational processes employed in the delivery of CAD-CAM-CNC subject due to the inherent advantages of using technology in pedagogical practices. Author developed two modified teaching learning approaches by incorporating computer assisted instructions with traditional teaching methodology. Through this work it is proposed to analyse attitude of teachers and learners towards traditional teaching and different blended learning approaches. All the teaching and learning methodologies used in this investigation have been explained below.

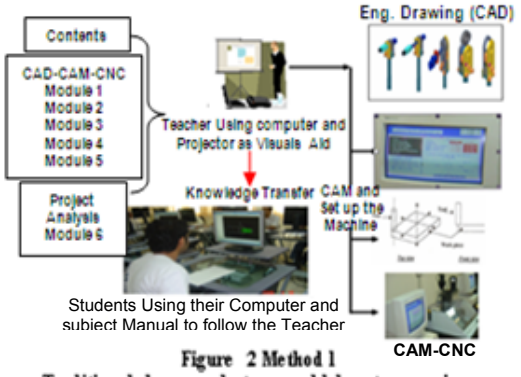

Figure 2 Method 1
Traditional classroom lectures and laboratory sessions

Method 1 - Traditional classroom lectures and laboratory sessions - The Lecturer explains various tasks that require memorization of factual information on routine procedures which include design and drawing (CAD) of an object and detailed description of manufacturing process (CAM-CNC). The Lecturer then shows students how the skills learned in classroom are used in practice by practical demonstrations of the procedures on actual CNC machine. Then students are encouraged to repeat these procedures in their own time without any support [5, 9, 10]**.** The Lecturer uses the computer interface of a projection unit to give theoretical background of the drawing process, explain standards and describe other activities. The resources available to students are CNC manual, exercise book and access to fifteen computers. The Lecturer supervises students continuously during this Lecturer-centred session (See figure 2).

Method 2 - Classroom teaching including supervised computer simulation – The Lecturer uses Autodesk Inventor [11] to describe CAD-CAM applications and the students can follow the suggested procedures and see the simulation results on the computer screen. The Lecturer delivers the lecture with the use of computer interface linked with the projector. The students are given CNC manual, exercise book and access to the computers to work in parallel with the Lecturer. The computer software describes the procedures step by step dynamically during the CAD session.

Various activities are included in the CAM-CNC part, for example: create cutting parameter for each part; generate tool paths for different layers for each part; generate final checklist for prototype etc. A software package is used to adapt a drawing file from a CAD program in DXF format and convert it into an NC code (CAM part). Each computer used by students is connected to a CNC machine tool so the generated NC program is used to actually cut the real work piece on the CNC machine (See figure 3). Therefore the students are exposed to the laboratory environment during CAM-CNC sessions and the lecturers demonstrate to them the practical procedures applied to real CNC machines. Also the students are provided with computer simulation models of these procedures which can be used flexibly [1, 5, 9, 12].

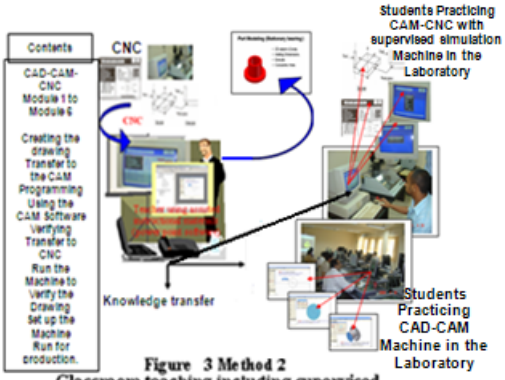

Figure 3 Method 2
Classroom teaching including supervised computer simulation

Method 3 - Unsupervised CAD tutorials and supervised CAM-CNC computer simulation- The Lecturer provides computer tutorials including video and animations which show the students how to use CAD (See figure 4). They are asked to study these in their own time (unsupervised study) and they have to solve exercises which are assessed by the

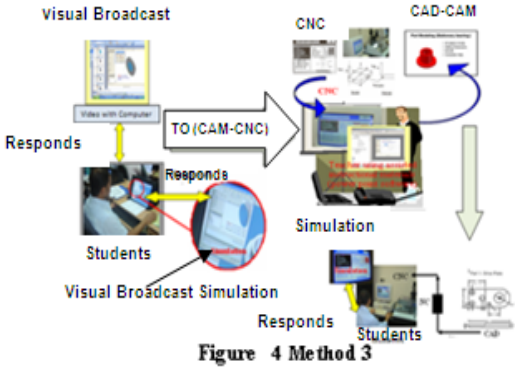

Figure 4 Method 3
Unsupervised CAD tutorials and supervised CAM-CNC computer simulation

Lecturers on the basis of a checklist. Students have the opportunity to switch between CAD programme

and Power Point slides and discuss the subject matter with each other (peer tutoring) so collaborative learning takes place. After this formative assessment stage, the students are given supervised demonstrations of application of CAM – CNC so the regulations for health and safety are fulfilled.
These three T & L methods are examined for their usefulness and acceptability with the students and teachers through well designed questionnaires.

Questionnaire Design Process
The questionnaires intend to examine the effectiveness of the three T & L methods versus the learning objectives for CAD-CAM-CNC modules. The changes included in the T&L strategy (see Method 2 and Method 3) aim to make learning personal, ensure learners get the information in the way they need it, their knowledge is immediately applied in the context of realistic working situations and can rectify mistakes in safe environments (simulation).

Method 2 and method 3 are shifting the emphasis from Lecturer-centred to student-centred learning by including computer tutorials that encourage learning through problem solving, discovery and enquiry. So the student-centred learning approach with interactive learning and teaching enables the development of employability skills (such as learning how to learn, understanding, evaluating and using knowledge and continuous improvement). This aspect was considered when formulating the questions addressed to Lecturers and students Robson et al [13] classify the enquiries in terms of their purpose and used research strategy. A tripartite classification has been used in the present investigation. Tripartite classification distinguishes between the principles and techniques necessary to gain data analysis. It covers the main issues of the preparatory work, provides information to clarify the object and purpose of the enquiry.
The first step in designing the research was to identify the research purpose which dictates the selection of the research methods, bearing in our mind the dictum that "*the purpose of the research determines the methodology and design of the research*" [14]. The second step was the design of questionnaires which was the main method of data collection. Then a pilot study was conducted for a number of students and Lecturers and the responses of the questionnaires were analysed.

The Lecturers' and students' questionnaire looks at the critical attributes of the teaching learning (T&L) process and assist in the identification of elements which need to be in place to promote learners progress and achievement. The questionnaires intend to ascertain how well the CAD-CAM-CNC modules meet the stated learning outcomes and to identify the main strengths and weaknesses of various T&L methods. Also it is intended to improve students' learning experience by increasing the student involvement in education process.
The lecturer's attitudes towards the teaching learning method and student's opinions and views about various aspects of teaching and learning (T&L) of CAD-CAM-CNC subjects such as: session planning and organising; delivery of course material and presenting the lesson; classroom management; assessment and feedback strategy; lecturers' participation and students' interaction have been analysed through the responses obtained.

Questionnaire Sampling – Three groups of 15 students from automotive, manufacturing, welding, and refrigeration courses have been taught by the three T & L methods as per the details given below:
Group 1 - traditional classroom lectures and laboratory sessions;
Group 2 - classroom teaching including supervised computer simulation;
Group 3 - unsupervised CAD tutorials and supervised CAM-CNC computer simulation
The present study was not carried out for whole population of mechanical engineering students of the institute due to factors such as expenses, time and accessibility [15]. This research employed the *probability sample* because it draws randomly from the wider population and allows the generalisation of questionnaire findings.

Analysis methods – generally the author (researcher on this case) analysed most of the items separately to provide specific information that contributes to the overall picture about teaching and learning provisions. The use of one item test is quite satisfactory when one is seeking out specific fact [16, 17]. The students' and Lecturers' answers were ranked according to the following scale:

Agree – Neutral (Undecided) – Disagree

The agreement and disagreement of each answer was calculated by the summation of frequencies and summation of percentages of the positive perceptions (agree), and the negative responses (disagree), and the third category is undecided.

Lecturers and Students Questionnaire
The aim is to find out the Lecturers perception of the teaching experience while teaching CAD-CAM-CNC topics, learning experience of students in the CAD-CAM-CNC module and effectiveness of the three T&L methods. The study has been carried out to explore problems during teaching and learning process in the subject area of CAD-CAM-CNC. The questionnaires have been formulated to understand the mechanics of the learning process from student's perspective. Previous studies [18, 19, 20, 21] suggested that a part of the problem in CAD-CAM-CNC subject area is the use of inappropriate teaching methods which affect students'

achievement. Through this students' questionnaire it has been attempted to elicit students' views and opinions about teaching and learning process. An attempt has also been made to understand Lecturer's experience of the T&L processes and a number of categories have been used to analyse teachers' and students' learning experiences. These categories have been designed to generate the interpretation and explanation of the teachers' and students' responses to the questionnaire. Various categories used in the questionnaire have been shown in the figure 5.

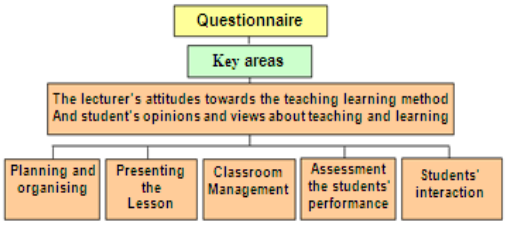

Figure 5 Key areas for lecturer's and student's questionnaire

Lecturers and Students responses:

Teachers and student's opinions and views about teaching and learning process under various categories are shown below.

1- Planning and organising the teaching session

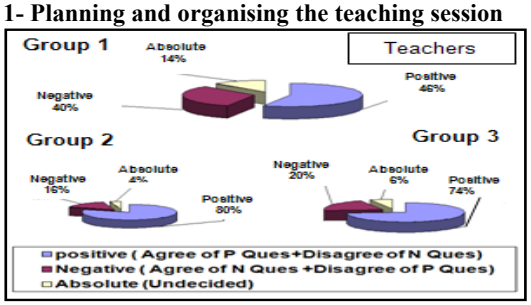

Figure 6 a-Teachers Response

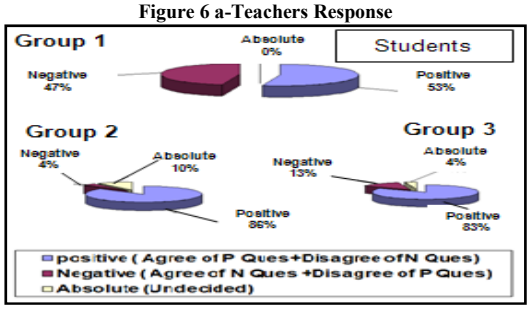

Figure 6 b-Students Response

These charts (6(a) and (b)) summarise the teachers' and students' responses to the issues pertaining to planning and organising the teaching session.

Overall positive response for group 1 process from teachers is 46% where as for group 2 and group 3 processes it is 80% and 74 % respectively. The corresponding negative responses from teachers are 40%, 16% and 20%. The above responses indicate that from the teachers' point of view it is easier to plan and manage blended learning methods. Similar conclusions can be derived from students' responses. Comparison of two responses indicates that students are more enthusiastic about blended learning methodology as compared to the teachers.

2-Delivering the instructional material

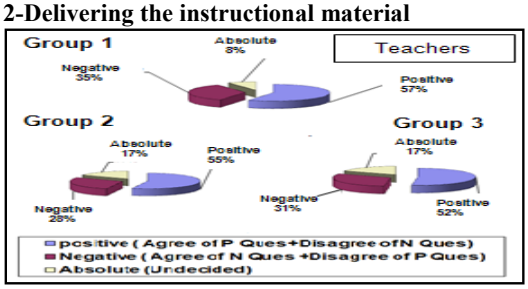

Figure 7 a-Teachers Response

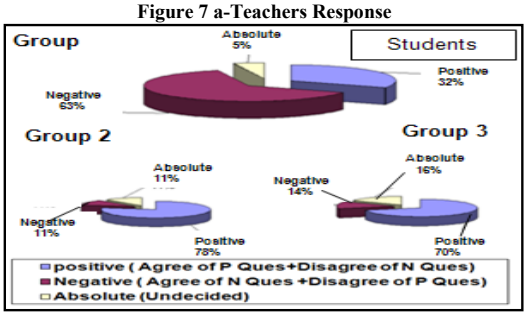

Figure 7 b-Students Response

These charts (7(a) and (b)) indicate teachers' and students' responses to the issues pertaining to delivery of instructional materials.

Overall positive response for group 1 process from teachers is 57% where as for group 2 and group 3 processes it is 55% and 52 % respectively. The corresponding negative responses from teachers are 8%, 17% and 31%. The above responses indicate that from the teachers' point of view it is easier to deliver instructions in traditional model as compared to blended learning mode. Students on the other hand feel that material is delivered best in blended learning mode.

3- Management of students within the classroom

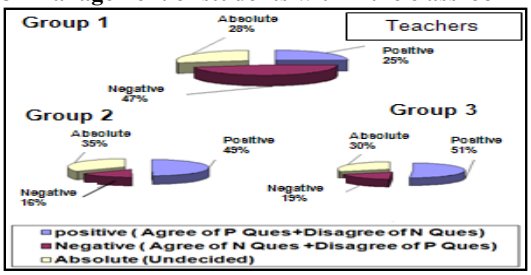

Figure 8 a-Teachers Response

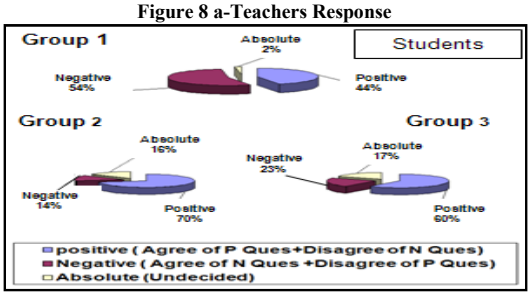

Figure 8 b-Students Response

These charts (8(a) and (b)) summarise the teachers' and students' responses to the survey issues pertaining to management of students within the classroom. Teachers feel that the management of students is easier in blended learning mode as compared to the tradition teaching mode. Similar conclusions can be derived from students' responses.

4- Assessment of students' performance

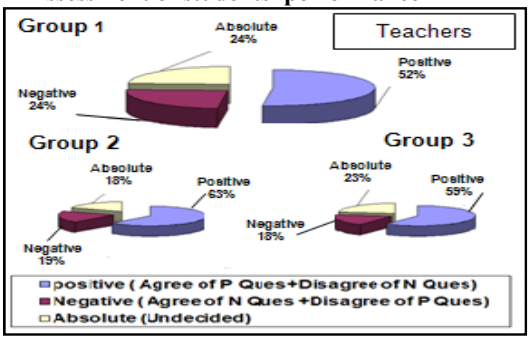

Figure 9 a- Teachers Response

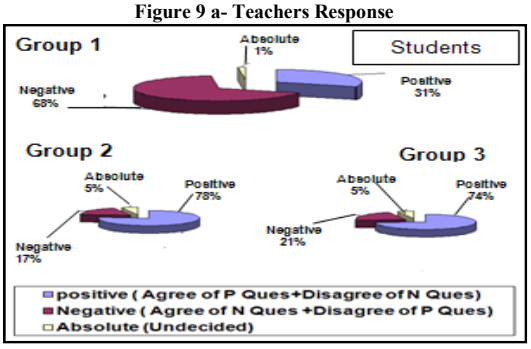

Figure 9 b-Students Response

These charts (9(a) and (b)) summarise the teachers' and student's responses to the issues pertaining to assessment of students' performance. Teachers' in group 1 indicate that it is easier to assess students' performance in the blended learning mode (63% and 59%) as compared to traditional teaching mode (50% positive responses). The students also feel that assessments are better and fairer in the blended mode as compared to tradition teaching and learning mode.

5- Class room interaction

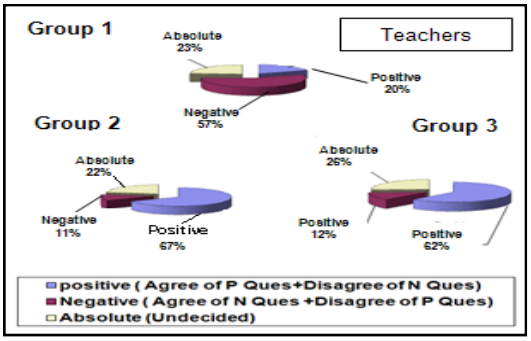

Figure 10 a-Teachers Response

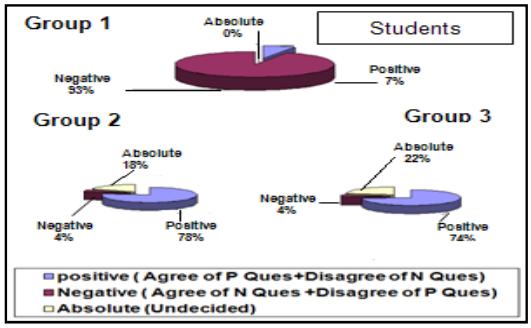

Figure 10 b- Students Response

These charts (10(a) and (b)) summarise the teachers' and students' responses to the survey items pertaining to class room interaction. Teachers' and students' both agree that in-class interaction is fairly limited in traditional teaching mode as compared to blended learning mode.

Results of five Categories

The overall result is shown below in the form of a Pie chart that depicts effectiveness of teaching learning process from teachers' and students' point of view for 5 categories namely: ***classroom organisation, lesson presentation, classroom management, assessment mechanisms and class room interaction.***

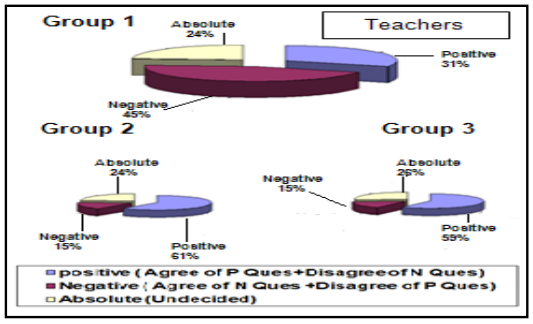

Figure 11 a- Teachers Response

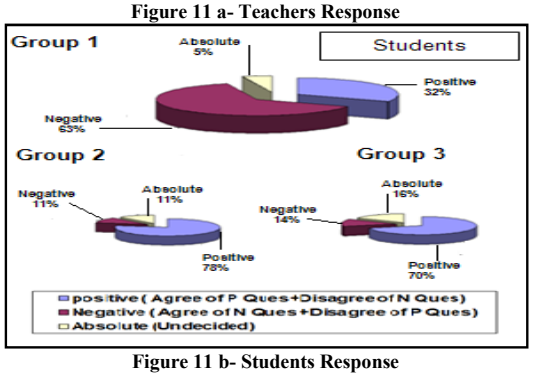

Figure 11 b- Students Response

Because of inherent complexities in teaching CAD-CAM-CNC module blended learning methods are considered to be better both by teachers and students. Integration of computing resources results in better planning, delivery and enhances classroom interactions. Assessment process is also much more consistent when computer assisted process are used.

Conclusions:

The main conclusions from this study are as given below.

- The computer as medium of instruction can be integrated with traditional teaching methods to make teaching and learning process more effective.
- Teachers feel that although there are some issues with the delivery of blended learning, blended learning model offers many advantages to the teachers in planning the lectures and assessing the students.
- Students feel that blended learning model has many advantages for them and are very positive on all aspects of blended teaching and learning mode.

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