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Abstract: The purpose of this study was to understand the effects of teachers' attitudes, effectiveness of various teaching methods employed as well as teachers' perceptions of the teaching experience on effectiveness of teaching-learning processes in computer-aided design/computer-aided manufacturing and computer numerical control (CAD/CAM/CNC) module used in vocational education department in Bahrain. Previous studies suggested that a part of the problem in CAD/CAM/CNC subject area is the use of inappropriate teaching methods which affect students' achievements negatively. It has been suggested that negative teaching practices for example, teaching without visual effects, lack of inter-action in the class and lack of motivational tool may affect students' achievement. A questionnaire has been developed to understand teacher's experience of the teaching learning process. The questions have been designed under the five categories. These categories are organisation, presentation, class room management, assessment process and teachers' perception of teaching methods used. These categories have been designed to help make the interpretation and explanation of the responses easier.

Keywords: Computer Technology

Introduction

THE AIM OF the present study is to find out the effectiveness of various teaching methods employed and teachers' perception of the teaching experience in CAD/CAM/CNC module as well as to analyse effects of embedding computer technology in the teaching and learning process. Previous studies Bhavnani, K., Suresh and John, E. Bonnie. (2000); Dye, R.C.F. (2003); Gall, E. James. (2002); R, W. Borg. D, M Gall.(1979)) suggested that a major problem in CAD/CAM/CNC subject area is the use of inappropriate teaching methods that affect students' achievements negatively. Introduction of computer technology in teaching and learning process needs to be well received by the teachers for it to be effective. Keeping this in view three groups of students were selected who were exposed to three different teaching and learning methodologies. Following are the three T&L methods which have been used in the present sudy:

1. Traditional classroom lectures and laboratory sessions;
2. Classroom teaching including unsupervised computer simulation
3. Unsupervised CAD tutorials and supervised CAM-CNC computer simulations

COMMON GROUND

These three T & L methods have been examined for their usefulness and acceptability with the Lecturers and students by using well designed questionnaires.

A number of 45 first-year students were divided into three equal groups (see Table 1):

Group 1 - exposed to method 1 (traditional classroom lectures and laboratory sessions);
Group 2 – subjected to method 2 (classroom teaching with unsupervised computer simulation);
Group 3 – exposed to method 3 (unsupervised CAD tutorials and supervised CAM-CNC computer simulation).

Table 1: Characteristics of the Three Groups of Students (Users)

Group Number	No of Students	Level of Student Marks	
		Average Marks	**Standard Deviation**
Group 1	15	67	5.84
Group 2	15	66.13	13.22
Group 3	15	66	12.57

Table 1 shows the characteristics of the groups used in present study. Group 1 has low standard deviation in marks which indicates a homogeneous group. Group 2 and Group 3 have high standard deviation marks so they are heterogeneous.

The Lecturers' questionnaire looks at the critical attributes of the learning processes and assists in the identification of elements that need to be in place to promote learners' progress and achievement. It has been suggested that negative teaching practices for example, teaching without visual effects, lack of interaction in the class and lack of some kind of motivational tool may affect the students' achievements. The Lecturers' questionnaires have been designed to find out Lectures' opinions about the following aspects of the three educational processes:

1. Planning and organisation of the teaching session;
2. Delivering the instructional material;
3. Management of students within the classroom;
4. Assessment of students' performance;
5. Lecturers' attitudes towards various T & L methods.

Through this **questionnaire** an attempt has been made to understand teacher's experience of the teaching learning process in the three teaching learning methods used. It is hoped that this will enable educational mangers to understand teachers' perspective on acceptability of computer aided instructions within teaching and learning processes.

Design of Questionnaire

The aim of the design of the questionnaire developed is to find out the lecturers perception of the teaching experience while teaching CAD-CAM-CNC topics and the effectiveness of the three T&L methods used namely, traditional teaching (group 1), teaching with a software (group 2) and teaching with a combination of traditional teaching and software (group 3).

Previous studies (Bhavnani, Suresh, Bonnie.2000; Dye, 2003; Gall, and James 2002; Borg, And Gall, 1979), have suggested that in the CAD-CAM-CNC subject area the teaching methods used affect student's achievement considerably. Through this questionnaire an attempt has been made to understand lecturers' experience of the T&L process and for this purpose the questions were divided into five categories (Figure 1). The questionnaire was designed by taking into consideration the issues of reliability, validity and bias and concentrating on specific study questions.

Table 2: Lecturer's Questionnaire

N0	Statement	Agree			Undecided			Disagree		
		G 1	G 2	G 3	G 1	G 2	G 3	G 1	G 2	G 3
		F	F	F	F	F	F	F	F	F
Teachers Organisation										
1	You always plan your lesson	8	10	10	1	0	0	1	0	0
3	You use your own techniques when you are preparing lessons	6	8	7	2	0	2	2	2	1
7	The syllabus is crowded so it is difficult to do more tasks work	8	2	2	1	0	0	1	8	8
14	When you prepare lessons you follow the techniques given in the teacher's guide	4	4	4	2	2	1	4	4	5
18	You add many examples to explain lessons	9	10	7	0	0	0	1	0	3
Teachers Presentation										
4	The majority of the students are interested in the way you present your lessons.	0	8	7	1	1	2	9	1	1
9	0nly the most able students like your lesson	7	1	3	1	4	1	2	5	6
6	You use lots of practical examples in your teaching	3	8	9	2	2	1	5	0	0
8	You use audio -visual aids	5	9	9	1	1	1	4	0	0
10	Students find it difficult to understand some drawing tasks or manufacturing tasks lessons because they cannot be presented simply	8	3	3	0	0	1	2	7	6
11	All the rules in your lesson can be presented simply	0	5	5	1	2	2	9	3	3

16	The students find difficulties in seeing the relevance of what you teach in CAD/CAM	8	4	3	0	1	0	2	5	7
5	Most of your lessons have the same pattern	8	9	6	1	1	2	1	0	2
28	You start the subject lesson by examples and then you explain the rules	7	3	3	1	2	0	2	5	7
29	You start the lessons tasks by explaining the concept of the subject and then you present the examples	6	10	7	0	0	2	4	0	1
21	You concentrate on drawing and manufacturing feature when you teach CAD/CAM/CNC lessons	7	2	2	1	1	3	2	7	5
52	Students are bored when I use the present method of teaching CAD/CAM/CNC	10	0	0	0	3	3	0	7	7
53	When I use the present method I don't need to use lots of teaching aids.	0	9	9	0	1	1	10	0	0
63	The variety of the examples in the present method helps the students to understand	1	8	7	0	0	1	9	2	2
Classroom Management										
30	You use group learning when you teach CAD/CAM/CNC.	4	9	8	0	1	1	6	0	1
12	Group work is an effective way of your teaching style	2	9	8	2	1	0	6	0	2
13	You want the theory time of your lesson to end quickly so you can do more practicing.	10	3	3	0	0	0	0	7	7
15	You encourage the students to ask Questions	6	8	9	1	2	1	3	0	0
19	You find it difficult to encourage the students in your lesson	10	3	2	0	0	2	0	7	6
22	You use dialogue with students during classroom activities	1	7	5	5	3	1	4	0	4
33	Students decide for themselves where they can sit in the classroom	7	9	9	3	0	0	0	1	1

34	Students are distributed inside the classroom to places or groups on the basis of their ability	8	1	2	1	3	1	1	6	7
35	The desks are arranged in the classroom in rows for batter visualisation	4	8	7	1	1	1	5	1	2
36	The desks are arranged in the classroom in groups to learn from each others.	1	2	7	2	5	0	7	3	3
37	Your students work together co-operatively on work that you gave to them	4	7	6	1	1	2	5	2	2
38	Your students work individually on work that you gave to them	4	5	6	1	1	2	5	4	2
61	The present method enables me to control the class.	2	6	7	0	1	1	8	3	2
62	The present method is suitable for a class with a large number of students.	2	6	7	0	1	1	8	3	2
64	The present method helps me to finish the tasks in time	2	7	7	0	2	1	8	1	2
65	The present method needs lots of time when I use it in teaching.	10	2	2	0	1	1	0	7	7
Assessment Mechanisms										
17	You ask your students after the lesson if they understand the lesson or not	10	10	9	0	0	1	0	0	0
20	You repeat the lesson if the students still have difficulties in understanding	3	7	10	1	1	0	6	2	0
24	You use standard when you teach CAD/CAM/CNC to judge the work	9	4	3	1	2	1	0	4	6
26	You use many shape and different exercises to improve the students' skills	7	2	2	0	2	1	3	6	7
27	You use many mechanical exercises to Measure student's performance.	8	1	2	0	1	1	2	8	7
39	Most of your questions can be answered by remembering previous lessons	7	9	9	2	0	0	1	1	1
40	It is difficult to ask questions which require students to apply knowledge	8	4	3	0	2	2	2	4	5

41	You often ask questions that require students to make judgments.	6	8	9	2	1	1	2	1	0
42	To evaluate the students' level in knowledge.	5	9	9	2	0	0	3	1	3
43	To help them to identify their weaknesses in CAD/CAM/CNC	4	9	9	1	1	1	5	0	0
44	Assessment feedback to treat their weaknesses.	9	9	9	1	1	1	0	0	0
45	You correct your students' mistakes	10	8	9	0	0	0	0	2	1
46	Easy mark the student's activities or exam tasks.	2	9	6	0	1	2	8	0	2
47	Easy to rate your students when they have the correct answer	1	7	6	0	1	2	9	2	2
59	The present method increases the students' achievement in CAD/CAM/CNC	0	7	8	0	2	0	10	1	2
Lecturer's Perception of Teaching Method Used										
2	You find subject matter in drawing and manufacturing you do not understand	6	7	6	2	0	2	2	3	2
23	It is difficult to understand every thing in the subject textbook	10	2	2	0	2	1	0	6	7
25	You enjoy your teaching style	1	7	6	3	2	1	6	1	3
31	You have friendly relationships with students	6	9	7	4	1	2	0	0	1
32	You keep formal relationships with students	0	3	2	5	1	1	5	6	7
51	The present method is successful in the field of teaching CAD/CAM/CNC	1	8	8	0	2	2	9	0	0
54	The present method encourages the students to learn.	3	7	8	0	1	1	7	2	1
55	I like to have training about the present method	2	9	9	3	0	0	5	1	1
56	The present method strengthens the CAD/CAM/CNC rules in the student's mind	4	7	7	0	3	3	6	0	0
57	Part of students' weaknesses in CAD/CAM/CNC is caused by the teaching method	9	2	3	0	3	1	1	5	6

58	The present method encourages the students to think logically	0	8	8	0	1	2	10	1	0
60	Teaching by the present method helps the student's to understand subject.	0	8	7	0	1	2	10	1	1
66	The present method does not encourage the students 'self- direct learning.	10	3	2	0	1	2	0	6	6
G = Group F = Frequency										
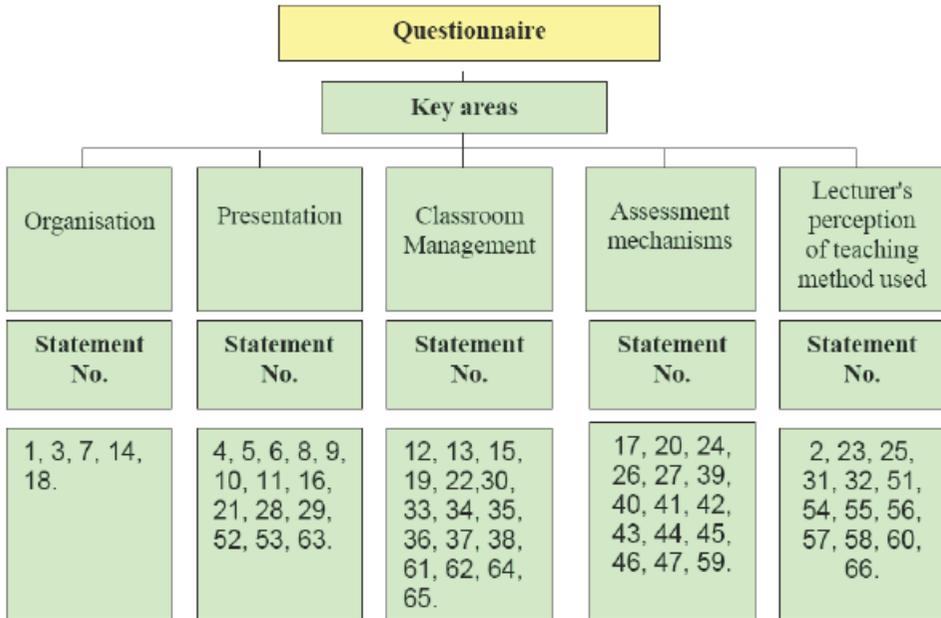
Figure 1: Key Areas for Lectures' Questionnaire

In all 66 questions were included in the questionnaire (table 2). The distribution of Lecturers' responses to the questionnaire is presented in the teacher Questionnaire and the results of quantitative data analysis for Lecturers' responses were divided in the five key areas.
The qualitative analysis of relevant Lecturers' responses is included below.

Key area 1 - Planning and organisation of the teaching session

• Only 20% of the Lecturers teaching Group 3 have their own blending techniques to prepare their lessons so the rest are using some written guidelines provided to assist with planning process to design their T&L sessions.
• All Lecturers teaching Group 1 (traditional T&L approach) are using the Lecturer's guide provided by the department because this method does not require the introduction of ICT in teaching.
• It is difficult to explain various tasks involved in CAD-CAM-CNC subject area without using a number of examples. So 90% of Lecturers teaching Group 1, 70 % of Lecturers

143

teaching Group 2 and 100 % of Lecturers teaching Group 3 agreed that they use many examples to explain various tasks in their lessons.
- The above findings clearly indicate that computer integrated teaching offers more opportunities to develop and plan instructions in a flexible manner which is tailored to the need of learners.

Key area 2 – Delivering the instructional material

- 90% of the Lecturers for Group 2 and Group 3 use visual aids as a normal part of their repertoire, where as only 50% of the Lecturers for Group 1 do it. The Lecturers were asked earlier in the current research if they had adequate teaching aids at institute, like TV, video, computer and handouts. 90% per cent of them said the support was inadequate. This indicates that enough provisions are not available in the institute.
- 80 % of Lecturers for Group 1 recognise that they have difficulty in presenting CAD-CAM-CNC topics because the traditional T&L method is not the most suitable one for discussing a module which requires visual presentation. However only 40 % of Lecturers for Group 2 and 30 % of Lecturers for Group 3 have difficulty in presenting the subjects. This may be because the computer technology is helping them to explain the difficult drawing and/or manufacturing tasks with ease.
- 80 % of Lecturers for Group 1 agreed that the students find it difficult to see the relevance of what they learn in CAD-CAM-CNC modules because it is difficult for them to make the connection between theory and practical applications with traditional T&L approach. Only 50% of Lecturers for Group 2 and 30% of Lecturers for Group 3 experience similar difficulty indicating scope for improved blending.

The above findings reinforce the view that computer aided instructions offer better visual descriptions and promote better learning in a module like CAD/CAM/CNC and teachers feel comfortable in using computer aided instructions.

Key area 3 - Management of students within the classroom

- 40 % of Lecturers for Group 1 agree that the group learning is an effective method for learning and learning effectiveness can be improved by giving students freedom in choosing activities in the traditional T&L approach. 80 % of Lecturers for Group 2 and 90 % of Lecturers for Group 3 agree with this concept because the unsupervised study of computer tutorials encourages communication among students resulting in better learning output.
- 100% of Lecturers for Group 1 find it difficult to encourage the students to participate in classroom activities because the traditional T&L approach is not conducive to students' interaction. However 70 % of Lecturers for Group 2 and 80 % of Lecturers for Group 3 were happy with their teaching methods and effective students' interaction that they could achieve when teaching with computer assisted simulations.
- 20% of Lecturers for Group 1 agreed that the traditional T&L method is suitable for a large group of students while 60% of Lecturers for Group 2 and 70% of the Lecturers for Group 3 agreed that the computer assisted teaching methods are suitable for classes

with large numbers of students. Once again the use of CAL package and CAI approach increases the effectiveness of T&L processes and helps in better class room management.

Key area 4 - Assessment of students' performance

- 100 % of Lecturers for Group 1 and for Group 2 are reinforcing the transmitted knowledge by asking relevant questions corresponding to different cognitive levels at the end of sessions. Only 90 % of Lecturers for Group 3 are doing the same thing because the extensive use of computer tutorials is helping students to understand better and solve various exercises easily.
- Only 60% of Lecturers for Group 1 encourage the students to express their opinions and evaluate their drawing and manufacturing parts for their usefulness because T&L approach is teacher-centred. A number of 80 % of Lecturers for Group 2 and 90 % of Lecturers for Group 3 are supporting students to have freedom in choosing their activities because the student-centred approach is conducive to this type of behaviour.
- 90 % of Lecturers for Group 1 find it difficult to rate the students' knowledge, understanding and ability because the traditional T&L method does not allow flexibility to use wider assessment mechanisms to ensure learning improvement. But 70 % of Lecturers for Group 2 and 60% of Lecturers for Group 3 find it easy to assess the students' work by using computers. They also find it easy to develop various assessments corresponding to different levels of different domains of learning.
- No Lecturer from Group 1 considers that the traditional T&L method increases the students' performance while 70 % of Lecturers for Group 2 and 80 % of Lecturers for Group 3 maintain that the use of CAI in educational process increases students' performance.
- The above findings indicate that it is easier to tailor the assessments to promote the learning process with computer aided instructions. Further a systematic outcomes based assessment can be easily carried out with computer aided teaching methodologies.

Key area 5 - Lecturers' attitudes towards various T & L methods

- 60 % of Lecturers for Group 1 and 70 % of Lecturers for Group 3 maintain that the work atmosphere is good and the students do not find it difficult to interact with Lecturers and ask relevant questions. However 90% of Lecturers for Group 2 communicate in a friendly manner with students. The higher positive response for group 2 and group 3 may be because of better working environment created with use of computer technology.
- 70 % of Lecturers for Group 2 and 80 % of Lecturers for Group 3 mentioned that the teaching method with support of computer technology encourages the students to learn. A number of 70% of Lecturers for Group 1 found it difficult to motivate students in the traditional T&L approach. The face-to-face lectures and Lectures' explanations for CAD-CAM tasks and CNC operations are not so appealing to students in a traditional teaching mode..
- 80 % of Lecturers for Group 2 and Group 3 have mentioned that CAL encourages the students to think logically (not only to memorise) since the structure of the drawing and manufacturing lessons is built rationally according to the students' needs. All Lecturers for Group 1 disagreed with this statement because in the traditional teaching the students

are following Lecturers' logic rather than thinking for themselves. This does not allow the Lecturers' to ensure learning effectiveness.
• The findings clearly indicate that computer aided instructions offer instructors to better engage with the learners and allow a better learning environment. Overall teachers show a positive attitude towards using computer aided instructions.

Conclusions

This study has clearly shown that computer aided instructions have considerable effect on teachers' attitude towards teaching and learning process in CAD-CAM-CNC sessions. Their attitudes and perceptions were determined by questionnaires (data collection methods) completed by Lecturers. Their answers were analysed from quantitative and qualitative points of view.

The study has analyzed the impact of technology-enabled instruction on students' levels of learning. It has been observed that hybrid learning method (CAI plus traditional methods) is most suited for CAD-CAM-CNC teaching because the students find it easier and enjoyable to explore the subject area through various opportunities of learning. Based on the individual responses and overall trends following conclusions can be forwarded for improved effectiveness of teaching and learning process.

1. The course material should be designed so the students are motivated and stimulated and they can develop/ apply the appropriate skills when dealing with complex problems within subject area.
2. The transition from teacher-centred approach to student-centred approach should be managed and student's views should be taken into consideration when planning, evaluating and updating the curriculum and teaching methods.
3. More attention should be given to support every staff member on how best to use CAL in their practice so the student experience is substantially improved by encouraging creativity and reflection (characteristics of lifelong learners).
4. Video and computer footages of real life contexts should be seriously considered in CAD-CAM-CNC modules (especially when the real situations have health and safety implicationsdangerous, time consuming, difficult to observe or expensive to be set up in the laboratory environment). The introduction of these pseudo-experiments (supported by video, animations, simulations) will facilitate small group learning and give students the control over their learning and increase their motivation, knowledge, understanding and performance.
5. Student critical thinking skills should be fostered through problem-based learning opportunities and innovative approaches to student-centred instruction (education). The developed CAL package needs some refining and afterwards could be used to achieve the above mentioned goals in Mechanical Engineering education.
6. More research should be performed regarding the effectiveness of technology-enabled instruction in engineering education, students' learning styles, preferences and attitudes toward asynchronous and synchronous learning and course management. In this way Sh Khalefa Institute will become a leading education institution in Bahrain in terms of using efficient ICT in modern education environment.

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