

## **CHAPTER 4 STATISTICAL ANALYSIS AND DISCUSSION OF RESULTS OF EVALUATION**

### **4.1 Introduction**

Educational system has a very wide definition. In my research, the scope of educational systems is systems that fall under the categories below.

- a. Information retrieval software
- b. Learning software
- c. Computer Based Training
- d. Analysis Software

I have chosen six (6) educational systems that fall under any of the categories mentioned above for evaluation in this research. In this chapter, I will discuss the educational systems that were used, the environment in which they were evaluated, the results of the evaluation that are displayed statistically on graphs, analysis of the results and lastly the discussion of the results.

The objectives of doing the analysis of the survey results are:

1. To analyze students' response on each of the category in the questionnaire for each of the six educational systems tested in this research.
2. To analyze the relationship between the social acceptability of the educational systems with the user characteristics, appropriateness of educational systems, rigidity of educational systems, method of delivery and goal and task characteristics of educational systems.

3. To analyze the relationship between the practical acceptability with functionality and communication issues in educational systems, lesson structure and display layout of educational systems.
4. To analyze the relationship of lesson structure with the mode of delivery of educational systems.
5. To use the results of the survey to serve as requirements for developing a prototype of educational system.

## 4.2 Descriptions of Educational Systems

### 4.2.1 Educational System (1): University Malaya Online Course-C programming

This website provides information on the courses that are held in University of Malaya. In this website, a student can discuss the courses that are being learned, electronically. This website can be accessed using any web browser by simply typing the address<sup>1</sup>

This website gives all the important details about a certain course that is accessed by simply keying in the respective username and password for the course. A student can access not only the notes but also announcements regarding the course, the lecturer's contact, the tutorials and discussion.

This particular web site gives access to many different courses held in University Malaya, but for this research I am concerned with one particular course which is C

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<sup>1</sup> <http://mdc.um.edu.my:88/mdc/mainmenu.nsf>



programming. This course is taken by a number of students from variety backgrounds. As for the evaluation, it will be discussed later in this chapter.

#### **4.2.2 Educational System (2): CosToc-Relational Database Courseware**

Costoc is a stand-alone courseware designed by Springer, which teaches the concepts of database to the students from the basic level to the intermediate level. It contains twelve (12) lessons and for each lesson a self-assessment test is given to test the understanding of learners.

In Costoc, each lesson is divided into few topics and the information is presented in colourful diagrammatic representations.

Students taking the Database Course at University Malaya were using this software for learning the concepts of databases. These students were asked to evaluate this courseware and the results are analyzed statically in this research.

#### **4.2.3 Educational System (3): Learning Microsoft Word 2000**

This software is presented online at the site.<sup>2</sup>

This site, which is published by the Central Institute of Technology, New Zealand, is designed to give students a course on using Microsoft Word 2000. This course is

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<sup>2</sup> <http://cit.rcc.on.ca/word2000/default.htm>

broken down into few chapters and each chapter consists of detail description on performing a specified task. Exercises are provided at the end of each chapter to test students' understanding.

Besides notes in text, there are also diagrams shown to facilitate students understanding on a skill. Therefore, students may experience a real life situation in using the Microsoft Word 2000 application.

#### **4.2.4 Educational System (4): Introduction to the Internet**

This course is available at<sup>3</sup>

This online hypertext is a work of Robert Brian Brown , developed in November, 2000. He has defined chapters in units and each unit teaches a certain concept of the Internet and World Wide Web. This is a simple online course without any exercises and tests to evaluate students' understanding.

#### **4.2.5 Educational System (5): Hardware Systems**

Robert Brian Brown at the site below presents this hardware systems course<sup>4</sup>

This particular course is categorized into few main modules and each module consists of few main topics. The notes are represented in text as well as in diagrammatic forms. At the end of the course, students can attempt the test questions in order to assess themselves.

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<sup>3</sup> <http://www.iitd.ac.in/cgi-bin/nph-p/http/10.116.2.57/courseware/internetupdate/default.htm>

<sup>4</sup> <http://www.iitd.ac.in/cgi-bin/nph-p/http/10.116.2.57/courseware/hs200/hstart.htm>

#### **4.2.6 Educational System (6): Operating Systems Introduction**

This Operating Systems course is an online course designed by Robert Brown Brian to accommodate students who want to learn about the Operating Systems. This courseware can be found at the site<sup>5</sup>

The notes are displayed in text as well as in pictures to show the real life examples.

There are few main sections and these sections are broken down into many topics to help students have an overall picture of the whole course. There are exercises in each section for the students to practice on. At the end of the course, students can do self-assessment by attempting the test questions.

### **4.3 Evaluation of Computer Systems**

#### **4.3.1 Evaluation of University Malaysia Online Course (C Programming)**

This online courseware is tested with a group of Engineering students who took the C programming course at the Engineering faculty in University of Malaysia. After a full semester taking the course using the online notes, an amount of 50 students from this faculty were asked to do the evaluation using the questionnaires prepared in this research.

#### **4.3.2 Evaluation for Costoc Relational Database**

The students taking the Computer Science major in Universiti Teknologi Mara (UITM) in Shah Alam, were asked to use the Costoc Relational Database system for their Database Systems course. Since, these students have been using the Costoc

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<sup>5</sup> <http://www.iitd.ac.in/cgi-bin/nph-p/http/10.116.2.57/courseware/opsys/assess.htm>

software for a couple of weeks, the students have familiarize themselves with the features and therefore, it was easier to carry on the evaluation. The evaluation was done with a number of 60 students taking the Database Systems course.

### **4.3.3 Evaluation of Learning Microsoft Word 2000**

The Institute Sejati, which is located at the Old Klang Road, offers computer courses for students who have just finish their secondary education. In a recent course on Microsoft Word 2000, a number of 25 students enrolled at this Institute. The Learning Microsoft Word 2000 online courseware is used to teach the students skills on using Microsoft Word 2000. After one (1) month of classes using this system, the evaluation was done for evaluating this courseware. The 25 students who took the Microsoft 2000 course were asked to test the Learning Microsoft 2000 courseware using the same set of questionnaires prepared for this research.

Like other evaluations, the results for this evaluation are also analyzed and discussed.

### **4.3.4 Evaluation of Introduction to the Internet**

Besides the Microsoft Word 2000 courseware, the Institute Sejati in Old Klang Road also had a basic course on Internet. The courseware "Introduction to the Internet" was used as one of the resources to enhance students' understanding. A number of 40 students, who took this course, did the evaluation of the "Introduction to the Internet" courseware with the questionnaires prepared in this research.

### **4.3.5 Evaluation of Hardware Systems Courseware**

The evaluation for this courseware was done by a group of students from Kolej Damansara Utama, taking the Information Technology courses. Twenty-five (25) students from this college were asked to navigate and use this courseware for the purpose of evaluation. They were given the questionnaires while using this courseware.

The evaluation results are analyzed statically and discussed in the next section.

### **4.3.6 Evaluation of Operating Systems Introduction Courseware**

The evaluation of the Operating Systems Introduction courseware was done with the students of the Limkokwing, Institute of Creative Technology in Petaling Jaya.. A number of hundred (100) students taking computer studies here have been asked to evaluate this online courseware.

The students here are quite familiar with this Operating Systems Introduction courseware since it was used to teach the Operating Systems course in this Institute. Therefore, the students knew the strengths and limitations of this particular system. The evaluation was done using the same set of questions prepared in this research.

## 4.4 Statistical Analysis and Discussion of Survey Results

In this research, I have prepared a set of questionnaires to evaluate the usability of computer systems used by the Malaysian students from a variety of backgrounds.

The questionnaires are divided into eleven (11) main categories, which are: -

1. User Characteristics
2. Goal/Task Characteristics
3. System Acceptability
4. Appropriateness
5. Method of Delivery
6. Functionality
7. Communication
8. Display layout
9. Program Rigidity
10. Navigational issues
11. Lesson structure

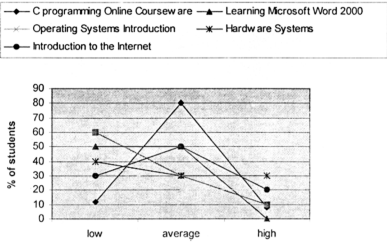
In this section, the analysis of the feedback by students, are done based on each of the category above. All the six (6) computer systems, which are evaluated are compared and analyzed based on these eleven (11) categories mentioned above.

The method of discussion of the results is discussed as follows: -

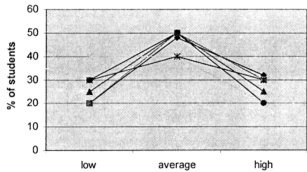
1. Results of survey are denoted as plots in the graphs.
2. Analysis of results according to each of the courseware evaluated.
3. Discussion of the results analyzed.

4.4.1 User Characteristics

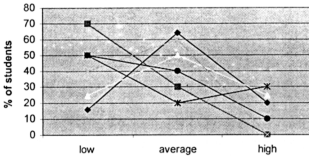
4.4.1.1 Results



Graph 4-1 - Experience level in using educational systems



Graph 4-2 - Users' Computer Skills



Graph 4-3 - Users English Proficiency

#### 4.4.1.2 Analysis

In this category, three issues were discussed, which are: -

1. User's level of experience
2. User's skill in using computers for learning
3. User's fluency in English

##### 4.4.1.2.1 User's level of experience

User's level of experience is divided into novice (low), basic (average) and expert (high). As we can see from Graph 4.1, most students have either a low or basic experience in the computer system. For the University Malaya online course, most users have basic experience in using the systems, whereas for Costoc Relational database system, Learning Microsoft Word 2000, Hardware Systems, Operating Systems Introduction v 4.0 and Introduction to the Internet online courses, most students have a low level of experience in using these systems. This means most of them are novices in using these systems. The mean of user's level of experience for all the six educational systems is 20%.



#### **4.4.1.2.2 User's skill in using computers**

User's skill is divided into low, average and high. As we look at Graph 4.2, it is obvious that most students have average skill in using computers for learning. From all the computer systems evaluated, only the Operating Systems courseware shows an equal percentage (40%) of students with low and basic level and the rest of the systems show a basic level of computer usage. The mean of user's computer skills for all the six educational systems is 21.3%.

#### **4.4.1.2.3 User's fluency in English**

The command of English is also divided into low, average and basic level. It is shown in the Graph 4.3 that most students have average level of English fluency. For the University Malaya online course, 64% of the students, for the Learning Microsoft Word 2000, 50% of the students and for the Operating Systems Introduction system, and 60% of the students have average command of English. For the Costoc relational database system, 70% of the students, for the Hardware Systems courseware, 50% of the students and for the Introduction to the Internet, 50% of the students have low command in English. Therefore, it is concluded that most students in Malaysia have either a low or average level of English literacy. User's English fluency for all the six educational systems evaluated has the mean of 15.5%.

#### **4.4.1.3 Discussion**

From the results and the analysis of the Graph 4.1, it is obvious that most of the Malaysian students are either novices or they have very basic knowledge in using educational systems for learning. This shows that these students are actually not well prepared to use these computer systems. The rest of the performance while using the

prepared to use these computer systems. The rest of the performance while using the computer systems is very much reflected by the students' prior experience. A novice's knowledge construction, differ from an expert's knowledge construction. Therefore, an educational system must be designed carefully, depending on user's prior knowledge in using courseware for learning. This must be determined before the development of an educational system.

Besides, prior knowledge, another characteristics that would affect the performance of a user using an educational system, is the user's computer skill in using computer systems for learning. From the Graph 4.2, we can see that most of the Malaysian students have average computer skill. They are not computer experts. Therefore, this requirement must be identified before an educational system is developed so that the Malaysian students could cope with the system and assist them in learning.

Another issue that must be noted especially for Malaysian students is the level of English used in an educational system. From the analysis on this issue in the Graph 4.3, it is obvious that most Malaysian students have either low or average English proficiency. Since language is the main communication between a user and a system, a user's performance and interest could be affected. Hence, before a system is selected, to be used for Malaysian students or before an educational system is developed, it is important to find out the most appropriate language to be used and also the level where it must be used.

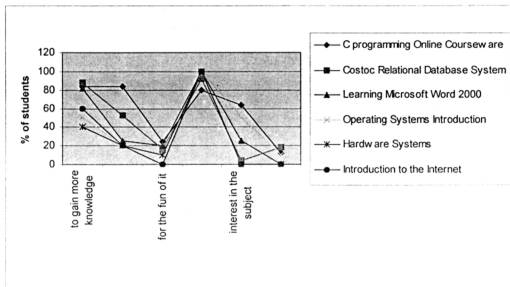
Only lately the Malaysian education system has been revived to accommodate computers in learning. Before this, computers were not emphasized in the education

system. Therefore students here who are currently in their tertiary level are not well exposed to the educational systems or even to the computers. Some of them still experience computer phobia. This is one of the cause students still have low skill in using computers or using the educational systems.

In the Malaysian education system, primary and secondary education is taught in Bahasa Malaysia. English has always been the second language in our education system. Therefore, students here are not used to learning in English. Furthermore, from the analysis of results in Graph 4.3, we notice that most students do not have good command of English. However, most educational systems that are being used in Universities and colleges in Malaysia are written in English. Some of the systems are foreign systems where the usage of English is quite high leveled. So, the consequences are reflected on the users' performance while using the systems. This problem must be taken into consideration while choosing an appropriate educational system or even developing an educational system for Malaysian learners.

## 4.4.2 Goal/Task Characteristics

### 4.4.2.1 Results



Graph 4-4 - Goal and Task Characteristics of using Educational Systems

### 4.4.2.2 Analysis

The goal and task characteristics consists of the characteristics mentioned below:

1. To gain more knowledge.
2. To learn new skills.
3. For the fun of it.
4. Part of course requirement in university
5. Interest in the course.
6. To retrieve information for problem solving.

For the University Malaya online C programming course, the main motivations were to gain more knowledge (84% of the students), to learn new skills (84 % of the

students) and part of course requirement in university/college (80% of the students). Another motivation chosen by 62 % of the students is interest in the course.

The most selected reason for using the Costoc relational database is part of course requirement in university/college (92% of students). The other two motivations, which seem to interest the students, are to gain more knowledge (88% of students) and to learn new skills (52 % of students).

For the Learning Microsoft Word 2000 system, the most noted reason for using this courseware is part of course requirement in University/college (100% of the students). The second highest motivation is to gain more knowledge (82% of the students).

Similar to the Learning Microsoft Word 2000 courseware, the main motivation to use the Operating Systems Introduction v 4.0 courseware is also part of course requirement in university (100% of the students). The other two motivations that were selected by 50% of the students are to gain more knowledge and interest in the subject.

The only main motivation that motivated the students to use the Hardware systems courseware and the Introduction to the Internet courseware is part of course requirement in University/college (100 % of the students).

In conclusion, the analysis shows that the most common goal to use most of this courseware is part of course requirement in University/college. The mean for

students who choose the educational systems because they are fun to use is only 15.8%. This means they do not opt for educational systems for learning.

#### 4.4.2.3 Discussion

Since all the educational systems that were evaluated were chosen to teach a certain course at the University or college level, most students choose the option, part of course requirement in university or college as their main motivation.

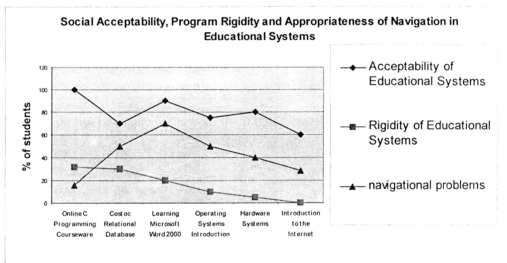
Other options that were identified by some of the students were to gain more knowledge and to retrieve information for problem solving. However, not many actually picked these two goals. Another goal, which is not widely identified by these students', is interest in the subject.

This shows that students in Malaysia use the educational systems mainly because it is stressed in their university or college curriculum. It is not because of interest and neither it is because they want to learn new skills. This could be due to many reasons where they feel it is more difficult to learn using educational systems or they do not have much skill in handling the computers for learning. Other reasons could be because they failed to achieve anything worthwhile after using these courseware and inappropriateness of these systems with the characteristics of Malaysian students.

The core point that I would like to stress in here is that, according to Graph 4.4, most students in Malaysia do not opt for educational systems if they want to learn something on their own. So, it is the time to design more usable, constructive and compatible educational systems for Malaysian students.

### 4.4.3 Social Acceptability, Program Rigidity and Appropriateness of Navigation

#### 4.4.3.1 Results



**Graph 4-5 - Social Acceptability, Program Rigidity and Appropriateness of navigation in Educational Systems**

#### 4.4.3.2 Analysis

According to Graph 4.5, the most acceptable system of all is the University Malaya online courseware. All the evaluators of this system accept it. The second most accepted courseware is Learning Microsoft Word 2000(90%), followed by Hardware Systems courseware (80%), Operating Systems Introduction v4.0 courseware (75%) and lastly Introduction to the Internet (60%). The mean of social acceptability for all the systems is indeed quite high which is 79.2%.

According to the evaluators (based on Graph 4.5), most computer systems are not rigid. For the University Malaya C programming online courseware, 32% of the evaluators say that it is rigid. 30% of the evaluators of Costoc Relational Database System, 20% of the evaluators of Learning Microsoft Word 2000 courseware, 10%

of the evaluators of Operating Systems Introduction courseware, and 5% of the evaluators of Hardware Systems agree that the systems they evaluated are rigid. None of the evaluators say that the Introduction of the Internet courseware is rigid. According to the students, all the educational systems tested are 14.2% rigid.

If the evaluators could answer more than half of the questions below, it means students do not have problems with the navigation of the systems.

1. Where am I?
2. How did I get here?
3. What can I do here?
4. Where can I go to?
5. How do I get there?

According to Graph 4.5, 84% of the students evaluated the University Malaya C programming online courseware does not experience problems with navigation. Navigation was an issue in Costoc Relational Database System where 50% of the students experience navigational problems. The Learning Microsoft 2000 courseware has bad navigation due to the fact that 70% of the evaluators seem to have navigational problems. 50% of the evaluators of the Operating Systems Introduction courseware do not have problems navigating this system. This percentage increased 10% for the Hardware Systems courseware, and it increased 20% for the Introduction to the Internet courseware. The mean of students who have problem with navigation, for all the educational systems is 42.3%.



#### 4.4.3.3 Discussion

The social acceptability in this context means how far is the educational system acceptable in the environment of its usage. From Graph 4.5, the author noticed that most Malaysian students do not have problems accepting these educational systems in their learning environment. A normal learning environment in Malaysian higher learning institutions is more teacher-directed whereas most educational system are designed for a constructive approach. This proves that students are not affected by the change of mode of learning, from teacher-directed learning to a more constructive learning.

According to Graph 4.5, most students claim that all the educational systems evaluated are not so rigid, this means they could use the system without much prior knowledge in the field of study. However, there were still few students who found these systems to be rigid. These could be the weaker students who could not understand the information delivered in these systems. So, it is important to find out the characteristics of target users before designing a usable system for them.

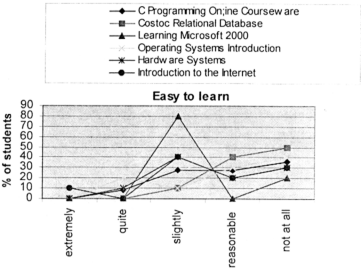
Users can get frustrated with the systems that are confusing and which can make them lost because they do not know where they came from, where they should go, or even how to exit the program. Users get frustrated with this experience, frequently losing sight of their original purpose in using the hypermedia or system.

Based on Graph 4.5, navigation has been a problem in all the systems evaluated except for the C programming online courseware. So, another criteria that must be

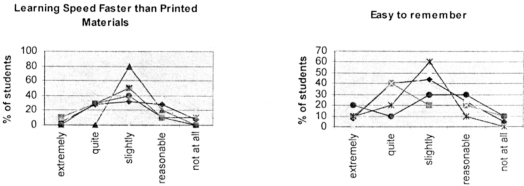
emphasized are the navigation criteria, which is essential in designing an educational courseware.

4.4.4 Practical Acceptability

4.4.4.1 Results

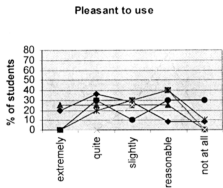


Graph 4-6 - Easy to learn

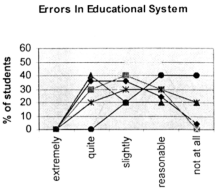


Graph 4-7 - Learning Speed faster than printed materials

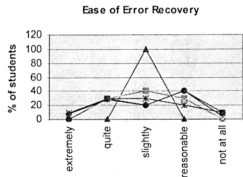
Graph 4-8 - Easy to remember



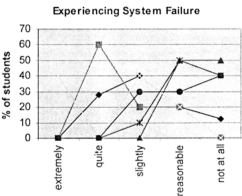
Graph 4-9 - Pleasant to use



Graph 4-10 - Errors in educational systems



Graph 4-11 -Ease of error recovery



Graph 4-12 - Experiencing system failure

4.4.4.2 Analysis

Practical acceptability includes the following issues: -

1. Easy to learn.
2. Efficient to use (faster to learn than printed form)
3. Easy to remember.
4. Pleasant to use (satisfaction in using the system)
5. Errors while using the system
6. Error recovery.

7. Reliability (system failure).

For each of the issues above, students have chosen the following options: -

1. Extremely
2. Quite
3. Slightly
4. Reasonable
5. Not at all.

**University Malaya online courseware:** Highest number of students, (36%) have chosen the quite option for the easy to learn issue. 32% of students slightly agree that this online courseware is faster than printed materials. 44% of the students slightly agrees that this courseware is easy to remember and 36% are quite satisfied using this system. 36% have chosen the quite option and 36% more choose the slightly option for the issue of making errors while using the system. 40% of the students feels that it is reasonably easy to recover from errors and around 40% also agrees that they slightly encounter system failure.

**Costoc Relational database system:** Among those who evaluated this courseware, 50% feels that this courseware is quite and 40 % feels that it is reasonably easy to learn. 50% of the students feel that it is slightly faster than printed materials. 40% agrees that it is quite, 20% agrees that it is slightly and another 20% agrees that it is reasonably easy to remember. 40% are reasonably satisfied with the system. 40% of the students who evaluated this courseware feels that they slightly make errors while

using this system and the rest choose the quite and reasonable options. Most students (60%) says that they encounter system failure quite often.

**Learning Microsoft Word 2000 system:** Most of the students (80%) feel that this courseware is slightly easy to learn. The rest (20%) feels that it is quite easy to learn. 80% of the students also feel that this online courseware is faster to learn than printed materials. The rest of them feel that it is reasonably faster than printed materials. 50% of the students says that it is slightly easy to remember, 25% says it is quite easy to remember and the rest 25% says it is reasonably easy to remember. One forth of the students is quite satisfied, another one forth is slightly satisfied, another one forth more reasonably satisfied and the last one forth is not at all satisfied with the system. 40% of the students say that they make quite a number of errors while using the system. All the students (100%) have stated that they slightly can easily recover from errors. Half of the ahs stated a reasonable encounter of system failure while the rest have not at all encountered any system failure.

**Operating Systems Introduction v 4.0 courseware:** 40% of the students agree that it is quite easy to learn. 40% of the students feel that it is quite fast to learn than printed form whereas another 40% feel that it is reasonably faster than printed form. 40% feel that it is quite and another 40% feel that it is slightly easy to remember. One quarter of the students are reasonably satisfied with the system and the rest are slightly satisfied. Half of the students have stated that they make slightly make many errors while using the system and the rest half says that they reasonably make many errors. Half of the students feel that they slightly can easily recover from errors. 40% has extremely encountered system failure while another 40% says that they slightly encounter system failure.

**Hardware Systems online courseware:** 40% feels this system is quite easy to learn and 30% slightly agree with this. 50% of the students have stated that they feel it is slightly faster to read than printed forms. 50% of the students also says that this system is quite easy to remember while another 30% says it is quite easy to remember. 60% of the students are slightly satisfied using this system. For the issue of making errors, 40% of the students have chosen the option of reasonable, 30% have chosen the option slightly, 20% choose the option quite and the rest 10% choose the option not at all. 30% says that they can slightly recover from errors easily and another 30% says that they can reasonably recover from errors. 30% says that they encounter system failure quite often and another 30% says that they slightly encounter system failure.

**Introduction to the Internet courseware:** 40% of the students agree that it is slightly easy to learn whereas another 30% says that it is quite easy to learn. 40% of the students also agree that this system is slightly faster to read than in printed forms. 30% of the students have stated that it is slightly easy to remember. 30% of the students are quite satisfied with the system, another 30% are reasonably satisfied whereas another 30% are not satisfied at all with the system. 40% of the students says that they make reasonable many errors while using this courseware while another 40% says that they do not make errors at all. 40% of the students selected the slightly option for the error recovery issue and for the last issue which is system failure, 40% do not encounter system failure at all, 30% of the students slightly encounter system failure and the rest reasonably encounter system failure.

In general, the mean of practical acceptability of all the courseware tested is 31.2%.

#### 4.4.4.3 Discussion

In practical acceptability, the issues that need to be considered are easy to learn, efficient to use, easy to remember, pleasant to use, few errors and reliability.

##### *Easy to learn*

According to Graph 4.6, students feel that the Operating Systems Introduction courseware and Hardware Systems courseware are easy to learn. This is because, they are quickly able to understand the most basic commands and navigation options and use them to locate wanted information. When they enter an information base for the first time, they are immediately able to understand the first screen and to browse it from. They are also are quickly able to learn the basic structure of the hypertext network and where or how to look for specific information. Users of these educational systems can learn the session without having to familiarize themselves with the entire hypertext or software structure. The contents of the information base are easy to understand.

The rest of the systems evaluated are easy to learn for some students and not so easy for the others. The systems are University Malaya C programming online courseware, Costoc Relational database courseware and Introduction to the Internet courseware. The different perceptions of students could be due to their characteristics, which are their experience in using those educational systems, their computer skills and English fluency. Other reasons could be due to educational systems themselves where these systems are wide in scope and are too technical. The contents could be difficult to understand.

Most of students feel the Learning Microsoft Word 2000 system is not so easy to understand. This could be due to the reason that this courseware contains very difficult information for the students to cope and the language used could be difficult to understand.

If an educational system is not easy to learn, learners will have difficulty in navigation and might get frustrated and disinterested to learn using the system. To avoid this, an educational system must be structured to assist students' understanding so that they can familiarize with the system quickly and concentration could be given to learning the contents rather than the learning to use the system.

### *Efficient to use*

Efficient in this context refers to how fast is learning using this system compared to learning the same subject using printed materials. According to Graph 4.7, students used the University Malaya online courseware and Costoc Relational Database System, admits that these systems are efficient to use. The speed of learning using these educational systems are faster than printed materials.

However, students who used the Operating Systems Introduction courseware, Hardware Systems courseware and Introduction to the Internet courseware feel that these systems are not efficient. They prefer printed materials rather than online and computer systems for learning these courses. It is because some students still could not accept learning using computers. Another reason could be because when the students arrive at a node, they could not quickly orient themselves and understand



the meaning of the node in relation to their point of departure. Therefore, these systems failed to cater for efficiency.

Efficiency must be taken into consideration seriously while designing an educational system as students who find a system inefficient would no longer use the system and fall back to printed materials for learning.

### *Easy to remember*

A system is easy to remember if students who left the system for some time could return to the system without having much problem using the system for the second time. From Graph 4.8, we could conclude that none of the systems evaluated are easy to remember. Students who return back to the systems after some time still find themselves as fresh users.

However, some students who evaluated the Costoc Relational Database system, Operating systems Introduction system and Hardware Systems find these systems to be slightly easy to remember.

The inability of students to remember a system is due to the reason that the system contains technicality, which is difficult to familiarize, and also the system is overloaded with too many features and too much information per screen. Therefore, students always find new things to explore each time they return to a particular system.

Malaysian students are also generally not use to learning using computers, therefore they take time to get familiar with an educational system and worst still if the educational system is too technical, they might have difficulties remembering it no matter how many time they use it.

### *Pleasant to use*

Pleasant to use in this context means, users prefer using the computer system to existing alternative solutions such as paper or others.

Students were asked to rate their satisfaction with the educational systems that they use. According to Graph 4.9, most students are satisfied with the University Malaya C programming online courseware and Costoc Relational Database System. The students are rarely frustrated with these systems and they are in control with respect to these educational systems. These systems are less constrained. However, this also depends on how good the user is in using computer systems.

For systems like Operating Systems Introduction courseware, Hardware Systems courseware and Introduction to the Internet courseware, students are less satisfied with these systems. They got frustrated using these systems and could not move freely as they want. This could be due to the students' low skills in using computers. Other reasons might be due to the courseware they use. A courseware, which is complicated, is definitely not pleasant to use.

An educational system that is pleasant to use for an American might nor be pleasant to use for a Malaysian student. Therefore, an educational system for a Malaysian

must be designed according to the characteristics of a Malaysian student so that it is pleasant to use.

### ***Errors while using the system***

Based on Graph 4.10, for all the educational systems evaluated, most of the students admit that they make errors while using the system. It is usual for students to follow a link erroneously but the question is whether these systems accommodate for error recovery.

### ***Error Recovery***

From Graph 4.11, most of the educational systems evaluated are not so good in error recovery. Most of the evaluators admit that they slightly could recover from errors while using these systems. Users could not easily return to locations where they have been, in case they decide that some lengthy digression should be. Therefore, these educational systems do not cater very well for error recovery and they are best suited for experts who do not make many errors while using these systems.

However, most Malaysian students are generally novices in using computers for learning. They have basic computer skills, which would lead to many errors while using an educational system. Hence, the educational system that would be best for Malaysian students should cater for error recovery and carefully design to suit novices as well.

*Experiencing System Failure (Reliability)*

According to the software heuristics defined by Nielson, [18] reliability of a software means it must have few bugs and follow its specification correctly.

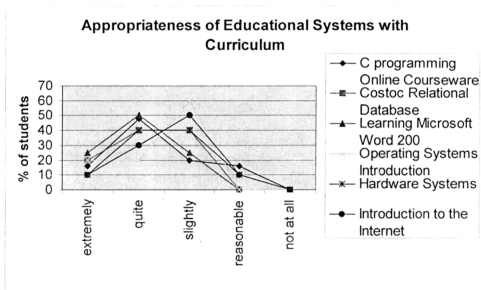
According to Graph 4.12, almost all the educational systems evaluated by the students considered not so reliable by the students. Only the Learning Microsoft Word 2000 and Introduction to the Internet courseware considered reliable by the students.

Students could not trust these educational systems because they did not work properly in their learning environment. For online systems, the network could not guarantee reliability, as network problem might not allow these systems to work as expected.

In an educational environment, students are required to finish a certain amount of work in a given time; therefore, the reliability feature is important to give them a fast response to finish their work on time

### 4.4.5 Appropriateness

#### 4.4.5.1 Results



**Graph 4-13 - Appropriateness of Educational Systems with Curriculum**

#### 4.4.5.2 Analysis

Evaluators were given the following options to evaluate the appropriateness of the system.

1. Extremely
2. Quite
3. Slightly
4. Reasonable
5. Not at all

**C Programming Online System:** From Graph 4.13, we notice that, 48% of the students agree that the courseware is quite appropriate, 20% of the students say that it

is slightly appropriate, 16% says it is extremely appropriate and the rest 16% says that it is reasonably appropriate.

**Costoc Relational Database System:** 40% of the students agree that this system is quite appropriate whereas another 40% says it is slightly appropriate. Another 20% says it is extremely appropriate.

**Learning Microsoft Word 2000 courseware:** 50% of the students have chosen the option quite, 25% of the students choose the option extremely and another 25% choose the option slightly.

**Operating System Introduction v4.0:** 60% of the students who used this system feel that this courseware is slightly appropriate, 20% feel that it is extremely appropriate and another 20% feel that it is slightly appropriate.

**Hardware Systems online courseware:** 40% of the students have chosen the option quite, 40% more choose the option quite, 10% choose the option extremely and the rest 10% choose the option reasonable.

**Introduction to the Internet system:** 50% of the students evaluated the feel that this courseware is slightly appropriate with the college/university curriculum. 30% admits that it is quite appropriate.

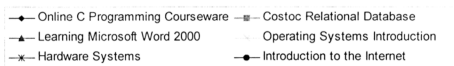
The mean of appropriateness of educational system with the university/college curriculum for all the systems is 19.5%.

#### 4.4.5.3 Discussion

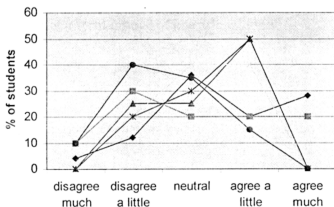
From the analysis of Graph 4.13, we could conclude that all the educational systems chosen for the students for learning a particular system are quite appropriate with the curriculum in University or college where the course is held. The contents of these educational systems are compatible with the syllabus being taught. Therefore, the Malaysian students do not have many problems accommodating the new syllabus in a computer form because it is basically the same thing delivered in another form, which is in the computer form.

#### 4.4.6 Method of Delivery

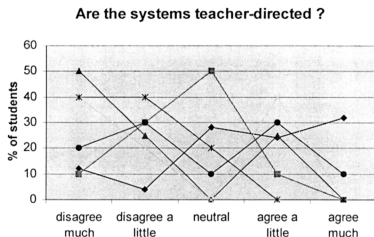
##### 4.4.6.1 Results



Preference of material in computer form instead of printed form



Graph 4-14 - Preference of material in computer form instead of printed form



**Graph 4-15 - Are the systems teacher-directed?**

#### 4.4.6.2 Analysis

There are two questions discussed in the method of delivery category, which are: -

1. Do you prefer having the manuals, textbooks and fiction available in an online/computer form instead of in a printed form?
2. Do you need to follow instructions from the teacher to use the system?

For each of these questions, evaluators had to choose one of the following options:-

1. Disagree much
2. Disagree a little
3. Neutral
4. Agree a little
5. Agree much



**University Malaya C Programming Online Courseware:** 36% of the students who evaluated this system were neutral about having this material in an online form. 28% of the students agree much on it and 20% more agree a little. The rest choose the disagree options. For the second question, 32% agree much that courseware system is teacher directed, 28% were neutral about it and 24% agree a little on this. The rest choose the disagree options.

**Costoc Relational Database courseware:** The evaluation shows that this system is not so preferred to be in a electronic form because 30% of the students disagree a little on having it this way and 10% more disagree much on this. 20% were neutral about it. The rest 40% of the students agree on it. 50% of the students were neutral about whether the system is teacher directed. 30% more disagree a little on this. Only a small percentage, choose the other options.

**Learning Microsoft Word 2000:** The evaluation of this system shows that 50% of the evaluators agree that this courseware is better in an online form than in printed form. 25% of the evaluators were neutral about this issue and 25% disagree a little. For the second issue whether the system is teacher directed, 50% of the evaluators disagree much and 25% more disagree a little.

**Operating Systems Introduction courseware:** 40% of the students who evaluated the were neutral about having this courseware in an online form and 40% more agree a little that it is better to have it in an online form. The rest 20% disagree a little on this issue. 40% of the evaluators disagree much that this courseware is teacher-directed whereas 40% more agree a little on this issue.

**For the Hardware Systems courseware:** 50% of the evaluators agree a little that this courseware is better in an online form rather than in printed form. 30% were neutral about it. 40% of the evaluators disagree much that this system is teacher-directed. Another 40% disagree a little and only a small number of the evaluators choose the rest of the options.

**Introduction to the Internet courseware:** 40% of the students who evaluated this system disagree a little that the system is better in an online form whereas 30% of the evaluators agree a little on this. 30% of the evaluators disagree a little on the second issue which is whether the system is teacher-directed. 30% more agree a little on this, 20% disagree much, 10% agree much and the rest 10% gave a neutral feedback on this.

In general, a mean of 14.2% students for all the educational systems prefer computer systems to printed materials and a mean of 50.2% says the systems are more teacher-directed.

#### 4.4.6.3 Discussion

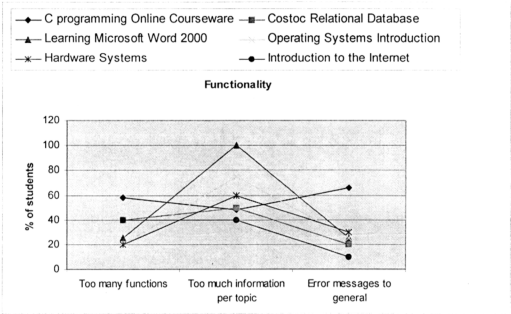
From Graph 4.14, the method of delivery of knowledge in computer form is quite accepted by most evaluators of all the six educational systems. However, many of the evaluators also gave a neutral feedback to this question. This concludes that the new method is accepted at times when there are fewer problems in the educational systems and at times when the educational systems do not work properly or not carefully designed, students tend to fall back to printed materials.

Students who feel that printed materials are better could be frustrated with the educational systems or could not accept this new paradigm in their educational system. Designing more usable educational systems for Malaysian students could improve students' perception on this method of delivery.

Based on Graph 4.15, most students also feel that they still need instructions from their lecturers to use these educational systems. They could not use them independently. This proves that, even with the usage of computers, the Malaysian students still depend on instructions from their lecturers in a particular learning environment. Therefore, it is the time to design more constructive educational systems for Malaysian students to minimize the dependency on lecturers. However, lecturers can become the guiders in using an educational system.

4.4.7      **Functionality**

4.4.7.1    **Results**



**Graph 4-16 - Acceptance of functionality of educational systems**

4.4.7.2    **Analysis**

58% of the evaluators of **Online C Programming Courseware**, 40% of the evaluators of **Costoc Relational Database System**, 25% of the evaluators of **Learning Microsoft Word**, 20% of the evaluators of **Operating Systems Introduction** and **Hardware Systems** and 40% of the evaluators of **Introduction to the Internet courseware** feels that there are too many functions in the respected educational systems that they evaluated.

Also, 48% of the evaluators of **C programming online courseware**, 50% of the evaluators of **Costoc Relational Database Systems**, 100% of the students of **Learning Microsoft Word 2000**, 75% of the evaluators of **Operating Systems**

**Introduction**, 60% of the evaluators of **Hardware Systems** and 40% of the evaluators of **Introduction to the Internet** courseware agrees that there was too much information per topic in the courseware they evaluated.

About the error messages being too general, 66% of the evaluators of **Online C programming courseware**, 20% of the evaluators of **Costoc Relational Database System**, 25% of the evaluators of **Learning Microsoft Word 2000** and **Operating Systems Introduction**, 30% of the evaluators of **Hardware Systems** courseware and 10% of the evaluators of **Introduction to the Internet** courseware agree to this issue.

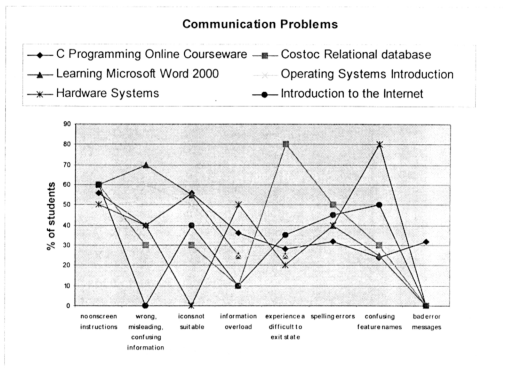
In conclusion, a mean of 30% acknowledge that there are functionality problems in all the courseware.

#### 4.4.7.3 Discussion

Based on Graph 4.16, students who experience functionality problems will be less interested in using the educational systems apart from affecting their productivity when using them. From the analysis above, it can be concluded that most of the educational systems tested have a certain amount of functionality problems in them. Therefore, it affects students' acceptability.

### 4.4.8 Communication

#### 4.4.8.1 Results



Graph 4-17 - Communication problems in educational systems

#### 4.4.8.2 Analysis

The issues in communication are: -

1. No onscreen instructions
2. Experience a state, which is difficult to exit (cancel a command).
3. Wrong, misleading and confusing information.
4. Spelling errors.
5. Usage of icons not suitable.
6. Confusing names to describe a feature in the system.
7. Information overload (too technical, too detailed until becomes very confusing).

#### 8. Bad error messages (usage of bad or foul language)

**University Malaya C programming online courseware:** Two issues, which are disturbed, by 56% of the evaluators are no onscreen instructions and wrong, misleading and confusing information. Another issue, which is pointed out by 40% of the evaluators are the experience of a state, which is difficult to exit. Other issues are not so obvious.

**Costoc Relational Database System:** The three main communication issues pointed out by the evaluators are no onscreen instructions (70%), usage of icons not suitable (80%) and confusing names to describe a feature in the software (50%). The evaluators do not emphasize other issues.

**Learning Microsoft Word 2000 courseware:** There are also three issues that are selected by most of the evaluators of this courseware. The issues are no onscreen instructions (60%), experience a state which is difficult to exit (70%) and wrong, misleading and confusing information (55%). Another issue which is selected by 40% of the evaluators is confusing names to describe a feature in the system.

**Operating Systems Introduction courseware:** 80% of the evaluators of the feel that this online system is overloaded with information. Another problem is that, a number of 60% of the evaluators experience a state, which is difficult to exit. 50% of the evaluators agree that the system consists of wrong, misleading and confusing information. A number of 40% also feel that that the names describing a feature in the system are confusing.

**Hardware Systems courseware:** The main issue pointed out by 80% of the evaluators of is also information overload. Another issue, which is noted by half of the evaluators, is no onscreen instructions. 40% of the evaluators feel that they experience a state, which is difficult to exit and the names describing a feature in the system are confusing.

**Introduction to the Internet courseware:** 60% of the evaluators who evaluated the feel that this system has no onscreen instructions. 50% of the evaluators feel that this system contains too much of information. Only 45% of the evaluators admit that the names describing a feature in the system are confusing and a number of 40% say that the courseware contains wrong, misleading and confusing information.

A mean of 34.3% says that there are communication problems for all the educational systems tested.

#### 4.4.8.3 Discussion

While using a system, a user should be able to find the answers to questions such as how do you find out the name of the program, how to exit and what keys to press for help. If a user could not find answers to these questions the system is considered as not having onscreen instructions. From Graph 4.17, since most of the educational systems evaluated **do not contain onscreen instructions**, this issue must be emphasized to minimize communication problem between an educational system and the learners.



**Hardware Systems courseware:** The main issue pointed out by 80% of the evaluators of is also information overload. Another issue, which is noted by half of the evaluators, is no onscreen instructions. 40% of the evaluators feel that they experience a state, which is difficult to exit and the names describing a feature in the system are confusing.

**Introduction to the Internet courseware:** 60% of the evaluators who evaluated the feel that this system has no onscreen instructions. 50% of the evaluators feel that this system contains too much of information. Only 45% of the evaluators admit that the names describing a feature in the system are confusing and a number of 40% say that the courseware contains wrong, misleading and confusing information.

A mean of 34.3% says that there are communication problems for all the educational systems tested.

#### 4.4.8.3 Discussion

While using a system, a user should be able to find the answers to questions such as how do you find out the name of the program, how to exit and what keys to press for help. If a user could not find answers to these questions the system is considered as not having onscreen instructions. From Graph 4.17, since most of the educational systems evaluated **do not contain onscreen instructions**, this issue must be emphasized to minimize communication problem between an educational system and the learners.

From Graph 4.17, only two of all the educational systems evaluated highly contain states that are **difficult to exit**. The systems are Learning Microsoft Word 2000 courseware and Operating Systems courseware. Computer programs should allow you to escape from undesired status. Failure to tell you how to escape is almost as bad as not providing an escape path.

Based on results in Graph 4.17, another common problem that are obvious in most of the educational systems that were evaluated is **wrong, misleading and confusing information**. This could be because of the level of English language used in the systems, which is beyond the understanding of some of our students in Malaysia. Most of the educational systems evaluated were foreign systems. So, they provide for a more global use.

From the analysis in Graph 4.17, we could conclude that these systems **do not contain spelling mistakes**. So, all these educational systems are well phrased and grammatically correct.

Based on Graph 4.17, although most students did not complain much on the **icons** issue except for the Costoc Relational Database system, this aspect of communication must be revived carefully for designing a usable educational system for Malaysian learners. Software of hypertext used by the Malaysian students are normally designed for global concern and not specifically designated to a special group of people. Icons that are sensitive in the Malaysian culture must be avoided so that the Malaysian students accept the system. The icons in the Costoc Relational Database system were misleading and not understandable. This could be due to the

reason of cultural differences where the metaphors used in this educational software were not appropriate in the Malaysian culture. Metaphors make the computer system seem similar to something you already know. They are good if they help the user predict the behavior of computer and bad if they lead the user to incorrect predictions.

From Graph 4.17, another communication problem that affects students while using the nine educational systems mentioned is **confusing feature names**. A feature name must be compatible with its command and therefore some of the commands used in these systems are not compatible with their names. Furthermore, the names might be appropriate for a certain culture, which is the designers' culture but not the Malaysian culture. Therefore, an educational system must be designed especially for students in Malaysian by considering the cultural aspect of Malaysian students.

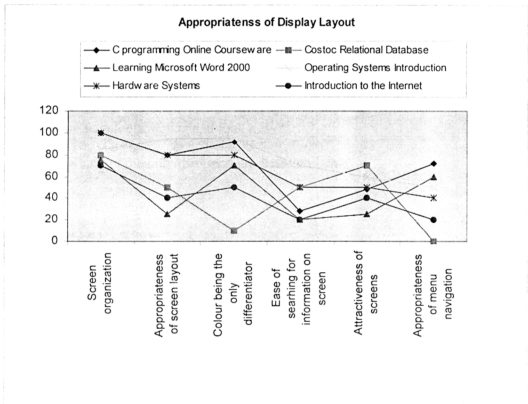
From the Graph 4.17 or even the analysis, it is noticeable that most of these educational systems are **overloaded with information**. The information in the software or hypertext is too technical and too detailed to the extent of confusing the answers that the students are looking for. Students find it difficult to cope and loose interest in using these systems. This must be considered in the design of a usable educational system.

According to Graph 4.17, students did not encounter usage of **foul language in the error messages** in all the six educational systems evaluated. However, this small but essential issue must be considered in the design of an educational system.

All the issues mentioned above must be considered carefully in the design of educational systems for Malaysian students.

4.4.9 Display layout

4.4.9.1 Results



Graph 4-18 - Appropriateness of Display Layout

#### 4.4.9.2 Analysis

The category of Display Layout consists of the issues below which are discussed in this section.

❑ **Screen organization and screen layout.**

1. Are the screens organized?
2. Is it easy to find what you want on the screen?
3. Is the screen balanced, rows/columns aligned?

❑ **Usage of colour.**

4. Is the screen distracting and look busy?
5. Is the colour the only differentiator between items?

❑ **Menu navigation.**

6. Is the menu navigation appropriate?

**University Malaya C programming online courseware:** All the evaluators of this system admit that the screens of this system are organized. 80% of the evaluators agree that it is easy to find what they are looking for on the screen. 92% of the evaluators also agree that the screens of this system are balanced. Only 28% feel that the screens are distracting and look busy. 48% of the evaluators feel that the colour is the only differentiator between items. 72% feel that the menu navigation is appropriate.

**Costoc Relational Database System:** 80% of the evaluators of agree that the screens of this system are organized and 50% admit that it is easy to find what they

want on the screens. Only 10% feel that the screens are balanced. 50% of the evaluators also feel that the screens are distracting and they look busy whereas 70% feel that the colour is the only differentiator between items. All the evaluators feel that the menu navigation is not appropriate.

**Learning Microsoft Word 2000 system:** 75% of the evaluators agree that the screens in this system are organized but only 25% feel that it easy to look for information on those screens. 70% also say that the screens are balanced and 80% of the evaluators agree that the screens do not look distracting and busy. 75% also feel that colour is not the only differentiator between items and 60% agree that the menu navigation is appropriate.

**Operating Systems Introduction courseware:** 85% of the evaluators feel that the screens of the are organized and 95% feel that it is easy to look for information on the screens and the screens are also balanced. 70% agree that the screens are distracting and they look busy. 60% of the evaluators agree that colour is the only differentiator between items and for the last issue which is menu navigation, half of the evaluators agree that the menu navigation is appropriate whereas the rest half say that it is not appropriate.

**Hardware Systems courseware:** All the evaluators who evaluated the say that the screens in the system are organized. 80% of the evaluators agree that it is easy to look for information on the screens and the screens are also balanced which means the rows and columns are aligned. Half of the evaluators agree that the screens look

busy and distracting and colour is the only differentiator between items. Less than half (40%) agrees that the menu navigation is appropriate.

**Introduction to the Internet courseware:** 70% of the evaluators admit that the screens in this courseware are organized. 40% of the evaluators agree that they find it easy to find what they want on the screens and half of the evaluators also admit that the screens are balanced. Only 20% of the evaluators find the screens to be busy and distracting and 40% agree that the colour is the only differentiator between items. But, 80% of the evaluators find the menu to be inappropriate.

In conclusion, a mean of 56% agree to the display layout of all educational systems.

#### 4.4.9.3 Discussion

From Graph 4.18, it is clearly stated in the analysis that students did not have problems with screen organization and screen layouts. Since, the screens are aligned and organized, it makes it easy for students to look for information on the screens. This issue did not affect student's perception about these educational systems.

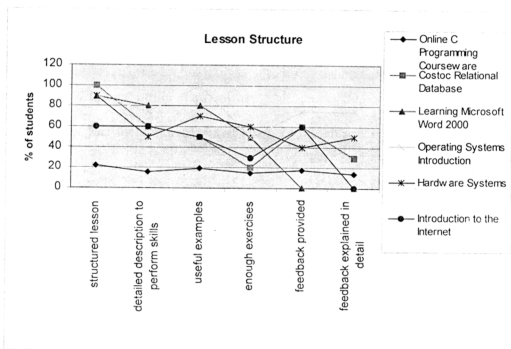
Based on Graph 4.18, most students agree to a certain extent that colour is the only differentiator between items. Therefore, these educational systems do not accommodate for students who are colour blind and those students who use the monochrome monitor. Students also feel that some of these systems contain screens, which are distracting and look busy. This shows that there is a problem of colour combination in most of these educational systems. A usable educational system for

the Malaysian students will include a specification of colours that are presentable and appropriate for the Malaysian culture.

According to Graph 4.18, for some of the systems evaluated especially the Costoc Relational database system, the menu navigation is not appropriate at all. Students could not easily move back to previous menu, move to the top of menu structure and leave the program at any time, able to jump to any topic they want. This means that these systems are not so usable for the Malaysian students.

#### 4.4.10 Lesson structure

##### 4.4.10.1 Results



Graph 4-19 - Lesson structure in educational systems



#### 4.4.10.2 Analysis

Evaluators are asked to answer Yes or No to the following statements: -

1. There is a structured lesson to teach specified objectives.
2. A detailed description on how to perform a specified skill is provided.
3. The lesson contains useful examples.
4. Enough exercises are provided for adequate practice.
5. Feedback is provided about required response.
6. When appropriate, feedback is explained in detail.

**University Malaya online courseware:** For each of the statements above, the percentage of evaluators that evaluated this courseware are, 22%, 16%, 19%, 15%, 18%, 14% respectively.

**University Malaya online courseware:** All the evaluators who evaluated this system agree that there are structured lessons to teach specified objectives. 60% of the evaluators agree that a detailed description is provided in this system and half of the evaluators of this system agree that the lessons in this system contain useful examples. Only 20% agree that there are enough exercises to adequate practice. Although 60% of the evaluators admit that feedback is provided for required response but only 30% feel that feedback is explained in detail when appropriate.

**Learning Microsoft Word 2000 online courseware:** 90% of the evaluators agree that there are structured lessons in this courseware and 80% of the evaluators feel that a detailed description is provided and the lessons contain useful examples. Half

of the evaluators of this courseware feel that the exercises in this system are enough. None of the evaluators agree that there is feedback for required response.

**Operating Systems Introduction system:** 90% of the students evaluated this system agree that there are structured lessons in this courseware. 75% of the evaluators agree that a detailed description is provided and all the evaluators say that this courseware contains useful examples. Half of the evaluators agree that the exercises in this system are adequate and 75% say the feedback is provided and it is explained in detail when appropriate.

**Hardware Systems courseware:** For each of the statements in the lesson structure category, the percentage of students who evaluated are 90%, 50%, 70%, 60%, 40% and 50% respectively.

**Introduction to the Internet system:** 60% agree on the lesson structure statement and also agree that a detailed description is provided to perform a specified skill. Half of the evaluators agree that the lessons in this courseware contain useful examples. Only 30% of the evaluators agree that enough exercises are provided for adequate practice and 60% feel that there is feedback for required response but none of the evaluators agree that the feedback is explained in detail when appropriate.

In conclusion, a mean of 50.2% agrees that the lesson structure of all the systems is appropriate.

#### 4.4.10.3 Discussion

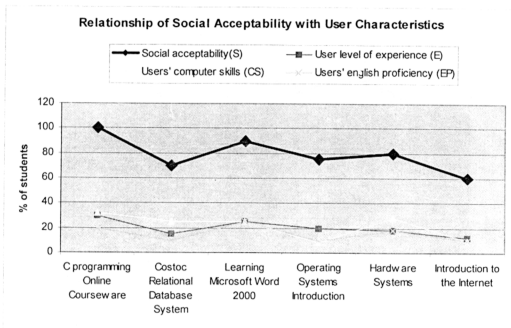
From Graph 4.19, we notice that, for University Malaya C programming courseware, the structure of lessons is not carefully defined for the students. There is no appropriate feedback provided for students for their response.

In the socio-constructivist view of learning, there must be structured lesson to teach specified objectives, a detailed description on how to perform a specified skill must be provided, the lesson must contain useful examples, there must be enough exercises for students' assessment and there must be feedback for students to test their response.

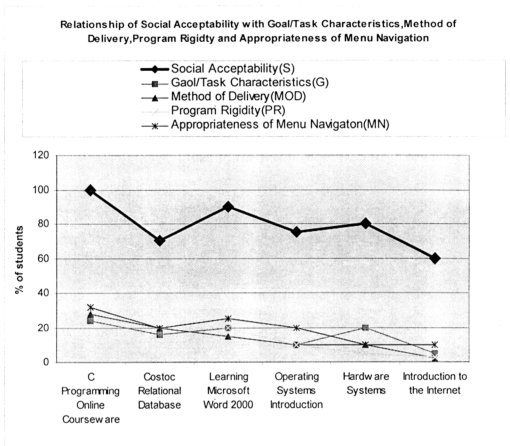
However, based on Graph 4.19, we notice that most of the systems being used for the Malaysian students do not contain these elements of the socio-constructivist view of learning. Therefore, a usable educational system must not only contain issues on interface and user characteristics but also pedagogical in learning.

## 4.5 Critical Analysis of Survey Results

### 4.5.1 Relationship of social acceptability with user characteristics, goal & task characteristics, appropriateness of educational systems, rigidity of educational systems and method of delivery issues



**Graph 4-20 - Relationship of social acceptability with user characteristics**



**Graph 4-21 - Relationship of social acceptability with goal/task characteristics, method of delivery, program rigidity and appropriateness of menu navigation**

When we look at the graphs above, we could see the relationship clearly denoted by the pattern of the plots.

As we could see in the Graph 4.20, a high level of user's computer skills (CS), experience (E) and English proficiency (EP) denotes in high level of social acceptability. Appropriateness and rigidity of educational systems also results in a higher level of user acceptance of the educational systems.

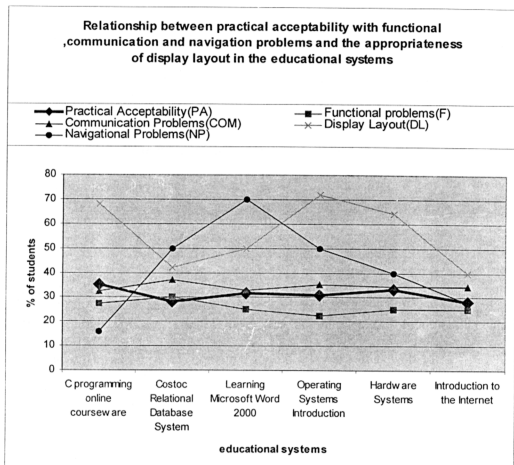
Besides that, it is also denoted in the Graph 4.21 that, the more the users prefer the educational systems to printed materials; the more the educational systems are socially acceptable to them.

Users who feel that an educational system is fun to use (according to plot G in Graph 4.21) besides having to use it due to the requirement in college or university, also shows a higher level of social acceptance of the courseware.

Graph 4.20 and Graph 4.21 show that the C programming online courseware to be most acceptable and Introduction to the Internet to be the least acceptable educational system among the six educational systems tested. The level of acceptance is influenced by aspects such as user's computer skill, level of experience in using educational systems, English proficiency, goal and task characteristics, rigidity of educational systems themselves, appropriateness of educational systems with college or university curriculum and also the preference of the systems to printed materials.

One of the main reasons for the high level of acceptance of the C programming online courseware is due to the fact that among the educational systems tested, this is the only courseware in Bahasa Malaysia. Rests of the systems were written in English. As we could see that, the level of English (according to plot EP in Graph 4.20) has tremendous influence in the level of acceptance of educational systems, this proves that an educational system written in Bahasa Malaysia is more accepted in the learning environment in Malaysia.

#### 4.5.2 Relationship of practical acceptability with appropriateness of navigation, functionality, communication, lesson structure and layout issues in educational systems



**Graph 4.22 - Relationship between practical acceptability and functional, communication and navigation problems and the appropriateness of display layout in the educational systems**

Graph 4.22 shows the relationship between the practical acceptability of the educational systems with communication, functionality and navigational problems and the appropriateness of display layout of the educational systems tested.

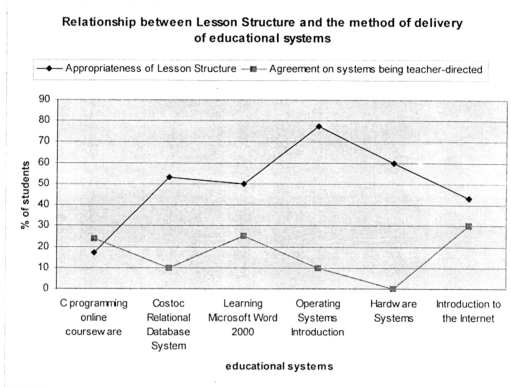
From Graph 4.22, we could see that, educational systems with a high level of practical acceptability (plot PA) have fewer communication (plot COM), functional (plot F) and navigational (plot NP) problems. They have appropriate display layout (plot DL) as well.

When we look at Graph 4.22, the practical acceptability does not differ much in all the six educational systems tested. However, the most practical to use among the six systems is the C programming online courseware. It has the best layout and few communication and functional problems as well. Besides that, it has the lowest navigational problems compared to the rest five educational systems.

Therefore, according to the trend of plots in Graph 4.22, an educational system, which is practical to use, should have less communication, functionality and navigational errors and it should contain a good display layout as well.



### 4.5.3 Relationship between lesson structure and method of delivery.



**Graph 4-23 - Relationship between lesson structure and method of delivery of educational systems**

In the socio-constructivist approach mentioned in this research, the learning must be learner control instead of being teacher-directed. According Graph 4.23, the educational systems with appropriate lesson structure seem to be less teacher-directed than the system with bad structure of lessons. For example, as we see in the Graph 4.23, the educational systems with low appropriateness of lesson structure, for example the C programming online courseware and Introduction to the Internet are more teacher-directed than the rest of the educational systems.

This shows that, a properly structured lesson in an educational system will help the users to explore on their own rather than depending the teacher to teach them. This way, the systems can be more learner control.

## 4.6 Conclusion

The analysis shows that acceptance of an educational system depends on aspects such as user characteristics, goal and task characteristics, appropriateness of educational systems with the college and university curriculum, functionality issues, communication issues, method of delivery of the systems, layout of the screens and navigational issues in the educational systems. It also shows that an appropriate lesson structure is important for imposing the socio-constructivist view of learning, which is more learner control than teacher directed.

Thus, when designing an educational system for target users, it is important to look at all the issues discussed above carefully so that it has a high level of user's acceptance and is constructive for the users.

The Table 4-1 shows the summarization of the evaluation results for all the educational systems evaluated in this chapter.

Category	Mean (%)
User's level of experience	20
User's skill in using computers	21.3
User's English fluency	15.5
Goal/Task Characteristics	15.8
Social Acceptability	79.2
Program Rigidity	14.2
Navigational Problems	42.3
Practical Acceptability	31.2
Appropriateness with curriculum	19.5
Preference of Computer Form	14.2
Systems being teacher-directed	50.2
Functionality Problems	30
Communication Problems	34.3
Display Layout	56
Lesson Structure	50.2

**Table 4-1: Summarization of Evaluation Results**

The main aspects, which were stressed as the requirements in the prototype developed in this research are presented below: -

1. Most Malaysian students have low or basic English proficiency. (According to Graph 4.3). According to Graph 4.20, it is more acceptable for them if the courseware that they use is developed in Bahasa Malaysia or in a low level of English.
2. It is important to specify the users experience level appropriate for using the courseware because as we could see in Graph 4.20, users experience level affects the acceptability of the courseware.
3. It is important to specify in the documentation, what computer skills users need to have to be able to use the courseware, as according to Graph 4.20, this affects the social acceptability as well.
4. The level of program rigidity should be according to the level of the courseware, for example, a courseware for novices must be less rigid than a courseware for experts.

5. Navigation should be appropriate, users should know where they are, how did they get there, what they can do there, where can they go and how to get there.
6. The courseware should minimize communication problems such as, no onscreen instructions; experience a difficult to exit state, wrong, misleading confusing information, spelling errors, usage of unsuitable icons, confusing feature names, information overload and bad error messages. This is because all the problems above affect the practical acceptability of the courseware.
7. The courseware must not have functionality problems such as, too many functions in one interface, too much information per topic, and error messages, which are too general.
8. Layout of the courseware must be organized and screen should not look distracting and too busy.
9. The courseware must not be teacher directed, as it follows the approach of socio-constructivism in learning. Therefore, it must contain appropriate lesson structure.

The above requirements are used in the design of the prototype in this research. The prototype development is discussed further in the next chapter.