International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 5 Issue 6 ǁ June. 2017 ǁ PP. 32-36

Effectiveness of Using Integrated Circuit Design Interactive CD in the course EE503 - IC Fabrication and Packaging Technology

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Abstract: *This paper examines the effectiveness of using Integrated Circuit Design interactive CD in the new course EE503 - IC Fabrication and Packaging Technology for the Diploma in Electronic Engineering (Computer) and Diploma in Electronic Engineering (Communication). The objective of this study is to assess the level of understanding of students with the use of interactive CD by lecturers in the teaching and learning process (T&L). The study was conducted on 30 respondents consisting of students taking the course EE503 in June 2012 session of Department of Electrical Engineering, Politeknik Seberang Perai. The survey conducted by distributing questionnaires to two (2) groups of respondents from different classes. Teaching and learning techniques for first responders group is carried out conventionally using powerpoint slides. While the teaching and learning for the second respondents group is a combination of using powerpoint slides and IC Design Interactive CD. The analysis was performed using SPSS 11.5 for descriptive average level of student understanding. The study found that the level of student understanding for the class that using Integrated Circuit Design interactive CD is higher than the classes that using power point slides only in the T&L. It shows that the use of Integrated Circuit Design interactive CD in T&L can increase the level of student understanding.*
Keywords: *Integrated Circuit Design, IC Fabrication, Interactive CD, Teaching and Learning*

I. INTRODUCTION

Academic achievement is very important in determining a course or programme objectives are achieved. There are several variables that affect academic achievement among students and in teaching and learning methods (T&L) that carried out in the classroom. Teaching conducted using conventional teaching notes and whiteboard has been revolutionized. Teaching instruments has grown with the use of a computer, projector and power point software helps students understand the courses taught. Multimedia materials also have a profound impact on student learning outcomes. However, the use of multimedia less exposure among the lecturers. Multimedia is different than media that only using text basic computer displays. Multimedia includes a combination of text, audio, images, animation, video, or interactive content forms. The variety of teaching methods in delivery is an important component to motivate student interest and involvement of the studies(Moores, 1987) [1].

Multimedia technology has in common with the textbook in terms of delivering information. However, the ability to manipulate text via electronic devices increases the potential for students to interact with the media, making it more attractive than a conventional note-taking. According Shavinina and Loarer (1999), multimedia applications commonly consist of at least 3 of the 7 components [2]:

1. Text. (Including notes, captions, subtitles and other resources such as tables of contents, indexes, dictionaries and support facilities)
2. Data. (Tables, charts, graphs and statistics)
3. Audio. (Speech, music, background sounds and sound effects)
4. Graphic. (Drawings, maps and posters)
5. Photographic Images (photographic images captured directly or created with the help of a computer)
6. Animation. (Either in the film or video or created with the help of a computer)

There are several ways that teacher can use to deliver lessons to students. For example, Mautone and Mayer (2001) studied the effects of three types of message signals in the teaching of (1) an explanation in text citations (2) verbal explanation such as speech and (3) an explanation and oral and visual animation [3]. Students who have received an explanation in this form of three different types message signals, is easier to give an answer within the given exam.

II. BACKGROUND TO THE STUDY

2.1 Issues and Concerns

Courses EE503 - IC Fabrication and Packaging Technology is an elective course offered to students on the 5th semester of Diploma in Electronic Engineering (Computer) programme and Diploma in Electronic Engineering (Communication) programme at the Politeknik Seberang Perai. The course syllabus consists of integrated circuit wafer from the process of preparation until integrated circuit packaging. This course focuses on the theoretical concepts and this helps students to memorize and get good exam results. From the theory of multiple intelligences proposed by Howard Gardner (1983) states that humans are able to master a variety of science based on the correct stimulus [4]. Thus, an action research conducted in the course EE503 - IC Fabrication and Packaging Technology with the using of Integrated Circuit Design Interactive CD.

2.2 Research Objectives

The study was conducted to obtain an overview of the use of interactive materials in the classroom. IC Design interactive CD used in EE503 - IC Fabrication and Packaging Technology course covers topics 2: Silicon And Wafer Preparation, Topic 3: Integrated Circuit Fabrication Process and Topic 4: MOS Transistor Fabrication. In particular, the objective of this study was to assess the extent to which the use of interactive CD can help enhance students' understanding. Research question is; Have a teaching aid in the form of multimedia, namely Integrated Circuit Design Interactive CD helps students understand the concept of wafer preparation to CMOS transistor fabrication sequence based on cross-section?

III. RESEARCH METHODS

The study was conducted by distributing questionnaires to the two (2) groups of respondents from two different classes which are Conventional group and Interactive CD group. Conventional teaching methods is carried out using conventional teaching notes and PowerPoint slides. While Interactive CD group is a combination of using power point slides and IC Design CD Interactive. Teaching and learning process is carried out for seven weeks. Teaching and learning process is monitored by the researchers to ensure that they take place in accordance with the requirements and objectives of the study.

3.1 Research Instrument

The instrument used for this observation is using the survey forms. The survey consists of three sections: Section A is about the students information, Section B contains statements related to the Topic 2: Silicon And Wafer Preparation, Topic 3: Integrated Circuit Fabrication Process and Topic 4: MOS Transistor Fabrication; Section C contains quiz questions to test the students' understanding. Each statement submitted require the respondent to respond on a scale established by the scale of 1: Strongly Disagree, a scale of 2: Disagree, scale 3: Agree and scale of 4: Strongly Agree.

3.2 Survey Sample

The samples were taken from 15 students of Diploma in Electronic Engineering (Communications) and 15 students of Diploma in Electronic Engineering (Computer) for the June 2012 session. Total number of respondents is 30 (Men = 15, female = 15).

IV. DATA ANALYSIS AND FINDINGS

Analysis were performed using SPSS software descriptive to get the average level of student understanding. Data were analysed using mean scores counting the percentage of students that show the level of student understanding. From the analysis, the mean score for the conventional group and interactive CD data set for each subject are shown in Table 1, Table 2 and Table 3.According to Table 1, it can be identified that the overall mean score of students' level of understanding of the Topic 2: Silicon and Wafer Preparation for the conventional group was 3.22 and interactive CD group a little high at 3.28.

Table 1: Mean score and standard deviation indicating the level of students understanding in the topic 2: Silicon and Wafer Preparation

Num	Statement	Conventional		Interactive CD	
		Mean Score	Standard deviation	Mean Score	Standard deviation
1	I can explain how the silicon produced starting from raw materials, namely sand	3.33	0.49	3.33	0.49
2	I can explain the Czochralski process with the aid of diagrams.	3.20	0.41	3.33	0.49
3	I understand the basic process for the preparation of the wafers' wafer slicing, " wafer lapping, " wafer etching "and" wafer polishing.	3.13	0.35	3.20	0.56
	Overall Mean Score	3.22	0.37	3.28	0.43

Table 2 shows the overall mean scores of the level of understanding of the Topic 3: Integrated Circuit Fabrication. Overall mean score for Conventional Group is 3.15, while for Interactive CD group is 3:29. (A little high).

Table 2: Mean score and standard deviation indicating the level of students understanding in topic 3: Integrated Circuit Fabrication Process

Num	Statement	Conventional		Interactive CD	
		Mean Score	Standard deviation	Mean Score	Standard deviation
1	I can define the process of 'doping' in the fabrication of integrated circuits.	3.07	0.26	3.20	0.56
2	I understand the process 'photolithography' in the fabrication of integrated circuits.	3.20	0.41	3.40	0.51
3	I understand the 'metallization' in the fabrication of integrated circuits.	3.07	0.26	3.27	0.46
4	I was able to define the process of 'etching'	3.20	0.41	3.33	0.49
5	I can differentiate between 'wet etching and dry etching'	3.20	0.41	3.27	0.59
	Overall Mean Score	3.15	0.23	3.29	0.48

Table 3: Mean score and standard deviation indicating the level of students understanding on the topic 4: MOS Transistor Fabrication

Num	Statement	Conventional		Interactive CD	
		Mean Score	Standard deviation	Mean Score	Standard deviation
1	I can explain the NMOS transistor fabrication process based on cross-sectional diagram (cross-section)	2.89	0.35	3.47	0.52
2	I can explain the process of making N-Well CMOS transistor based on cross-sectional diagram (cross-section).	2.93	0.46	3.40	0.51
3	I can draw the physical structure of the transistor CMOS P-Well.	3.00	0.00	3.47	0.52
4	I can draw the physical structure of a CMOS transistor Twin-tub.	3.00	0.38	3.33	0.49
5	I can draw the physical structure of the transistor CMOS silicon on insulator (SOI)	3.07	0.26	3.33	0.49
6	I can identify the problems inherent in the operation of the transistor.	3.00	0.00	3.47	0.52
7	I can explain the effect of 'latch-up' in the operation of a transistor circuit	2.93	0.26	3.47	0.52
8	I can explain the method to solve the problem of 'latch-up'	3.13	0.35	3.47	0.52
	Overall Mean Score	2.99	0.11	3.43	0.40

Based on Table 3 can be obtained, the overall mean level of understanding for the topic 4: MOS Transistor Fabrication of an interactive CD group (mean score = 3.43) higher than in the conventional group (mean score = 2.99).

Table 4: Overall mean score indicating the level of student understanding

Num	Statement	Conventional		Interactive CD	
		Mean Score	Standard deviation	Mean Score	Standard deviation
1	Topic 2: Silicon And Wafer Preparation	3.22	0.37	3.28	0.43
2	Topic 3: Integrated Circuit Fabrication Process	3.15	0.23	3.29	0.48
3	Topic 4: MOS Transistor Fabrication	2.99	0.11	3.43	0.40
	Overall Mean Score	3.08	0.10	3.36	0.37

The analysis showed that the overall mean score of the level of student understanding for the Interactive CD group (mean score = 3.36) higher than the conventional group (mean score = 3.08) (Table 4). Topic 4 obtain the highest mean score of the level of understanding compared to Topic 2 and Topic 3, which shows the use of an interactive CD is helping students understand especially in Topic 4.

Topic 4 discusses MOS transistor fabrication process. Among the outcomes of this topic, students should be able to (1) describe the sequence of the fabrication process of the NMOS transistors and N-well by the cross section of the wafer (2) drawing the physical structure of the transistor's P-well, Twin Tub and Silicon On Insulator (SOI) and (3) identify and describe the problems inherent in the operation of a transistor circuit (latch-up).

Learning outcomes (1) can be measured by items question 1 and 2 which is 'I can explain the NMOS transistor fabrication process based on cross-sectional diagram (cross-section)' and 'I can explain the process of making N-Well CMOS transistor based on cross-sectional diagram (cross-section)'. The mean score of students' level of understanding of interactive CD set high scores for both items, in contrast to the conventional group of students low score only 2.89 and 2.93 (Table 4). This shows, interactive CD group of students believe they are able to explain the fabrication process of the NMOS transistors and CMOS N-Well over a cross-sectional diagram well.

Learning outcomes (2) can be identified by items 3, 4 and 5, while items 6, 7 and 8 represents the learning outcomes (3) (see Table 4). The findings of the learning outcomes (3) supported by an analysis of the quiz question's no.9, 'Latch Up' occur due to the epitaxial layer between the p-n junction depletion. A total of 86.7% of students use interactive CD answers the quiz question correctly than those who do not use interactive CD is only 40%.

4.1 T-Test for Two Independent Samples

In this study, an analysis using t-test for two independent samples is carried out to determine whether there is a significant difference in the mean of the two independent samples of each other, a group which T&L activities is carried out in the conventional method and the other group who underwent T&L using interactive CD.

μ_1 = mean score of students' level of understanding who undergo conventional T&L.
μ_2 = mean score of students' level of understanding who underwent T&L uses an interactive CD.

Null hypothesis, H_0:
There are no significant difference between the mean scores of students' level of understanding of the group who underwent conventional T&L and undergoing T&L use interactive CD. (H_0: $\mu_1 = \mu_2$)

Alternative hypothesis, H_a:
There are significant differences between the mean scores of students' level of understanding of the group who underwent conventional T&L and undergoing T&L use interactive CD. (Ha: $\mu 1 \neq \mu 2$)

The significant level used is, $\alpha = 0.05$ (confidence interval: 95%) [5]

Levene test for equality of variances are not significant ($p = 0.000 < 0.05$) showed that both groups of students undergoing conventional T&L and use interactive CD has different variants (See Table 5). This means that the null hypothesis which says that the variance of the group of students who underwent conventional T&L is equal to the group using the interactive CD is rejected. Thus, the results of t-test to compare the mean of two groups independent sample which has the same population variance is not taken into account (equal variances not assumed).

Based on the analysis, given the probability derived from SPSS 11.5 (0.014) is less than the value specified α ($\alpha / 2 = 0.025$), the null hypothesis is rejected [6].There is strong evidence to conclude that $\mu 1 \neq \mu 2$. This means that there are significant differences in the mean scores of students' level of understanding of the group who underwent conventional T&L and undergoing T&L use interactive CD. Group of students undergoing T&L use interactive CD has a mean score higher level of understanding than the students who undergo conventional T&L.

Table 5: Test samples are independent.

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	26.168	.000	-2.748	28	.010	-.2750	.10006	-.47997	-.07003
Equal variances not assumed			-2.748	16.075	.014	-.2750	.10006	-.48704	-.06296

V. DISCUSSION AND CONCLUSION REVIEW

Based on the findings and analysis of the study found the use of an interactive CD as teaching aids by the lecturer in the course EE503 - IC Fabrication and Packaging Technology can help improve students' understanding. MOS Transistor Fabrication topics in CD Interactive, which has animation and voice-identified

can help students, especially in 1) describing the sequence of the fabrication process for the NMOS transistor and N-well by the cross section of the wafer, 2) drawing the physical structure of the transistor P-well, Twin Tub and Silicon On insulator (SOI) and 3) identify and describe the problems inherent in the operation of a transistor circuit (latch-up). This is consistent with studies by Mautone and Mayer (2001) which says that the explanation in the form of oral and visual animation in the process of learning can help improve students' understanding [3]. According to Howard Garner, there are 8 multiple intelligences in human beings and one of them is a visual spatial where humans learn through visual, visualization, colour, painting and metaphor (Armstrong, 1994) [7].

In the study by Ikhsan & Rohizan (2010), also suggested that teachers try variations teaching methods or techniques to help prevent students from experiencing boredom during the process of teaching and learning, in addition to developing the potential of multiple intelligences [8]. Accordingly, the lecturers are encouraged to develop multimedia material as a teaching aid in the classroom. It can further diversify the teaching and learning methods to students, who have a variety of intelligence.

VI. PROPOSED FURTHER STUDY

Although the study found significant differences in the level of understanding of a group students who underwent T&L uses an interactive CD which is higher compared to conventional T&L. However the samples obtained is small because of the course EE503 - IC Fabrication and Packaging Technology is an elective course. Therefore recommended further study using a larger sample is carried out with the involvement of several polytechnics.

REFERENCES

[1] Moore (1987); Thomas D. Sharts (2015); The Science and Art of Effective Secondary and Post-Secondary Classroom Teaching: Xlibris
[2] Shavinina, L. & Loarer, E. (1999). Psychological Evaluation of Educational Multimedia Applications. European Psychologist, 4(1), (33-44).
[3] Mautone, P. D., & Mayer, R. E. (2001) Signaling As A Cognitive Guide In Multimedia Learrning. in Journal of Educational Psychology 93(2), 377-389.
[4] Gardner, H. 1983. Frames of Mind: The Theory of Multiple Intelligences. New York: Basic Book.
[5] Sulaiman Shamsuri (2009) Research Method For The Social Sciences Made Simple Second Edition. DSS Publishing Enterprise
[6] Zaidatuin Tasir & Mohd Salleh Abu (2003) Analisis Data Berkomputer SPSS 11.5 for Windows. Venton Publishing.
[7] Armstrong, T. (1994). Multiple intelligences in the classroom. Alexandria: Association for Supervision and Curriculum Development.
[8] Ikhsan Othman & Rohizani Yaakub (2010) Aplikasi Teori Kecerdasan Pelbagai Dalam Pelaksanaan Kurikulum. Asia Pacific Journal of Educators and Education. Vol. 25, 21–32, 2010
[9] Lay Yoon Fah & Khoo Chwee Hoon (2009) Pengenalan Kepada Analisis Data Komputer dengan SPSS 16.0 for Windows. Venton Publishing.
[10] Zulkarnain Zakaria (1999) Statistik Pengurusan. Penerbit Universiti Utara Malaysia, Sintok.