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EFFECT OF HAVING THEORETICAL QUESTION IN FINAL EXAMINATION FOR 'INTRODUCTION TO MICROELECTRONICS' (ELE 245)

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Abstract

Introduction to Microelectronics (ELE 245) is one of the compulsory courses for Electrical Engineering student majoring in electronics. This course basically exposing students on basic concept of physics and properties of semiconductor, PN junction, fabrication process and integrated circuits (IC) design flow and layout. In general, there are several factors that influenced students' in academic performance, such as students' engagement in class, attitude, effects of social support and lecturer's teaching method. This paper studied the effect of having theoretical question in final examination for ELE 245 course. In this paper, the respondent is comprised of students' whom taking this course throughout previous 3 semesters. The data(s) were collected from Result Entry System, which then use to calculate the overall marks, including test, assignment, quiz, laboratory report and final examination thus producing the final grade for each student. From the results, it was found that the theoretical type of question was not favourable to be answered compared to calculations or design questions. In order to improve students' understanding in theoretical part we proposed to develop an experimental learning process environment.

Keywords: Microelectronics, Theoretical, Result Entry System, Academic Performance

1.0 INTRODUCTION / BACKGROUND STUDY

Introduction to Microelectronics (ELE 245) is one of the compulsory courses for students in their fourth semester majoring in electronics. This course was offered by the Faculty of Electrical Engineering, Universiti Teknologi Mara (UiTM) Terengganu. It consists of five (5) main chapters. The first chapter is about semiconductor's physics and properties. It explained on the energy bands, energy gap, crystal structure, covalent bonding and also doping of semiconductor with impurity atom. While chapter two elaborates on PN junction's depletion region, current voltage characteristic, junction breakdown, transient behaviour and noise terminal functions. Normally, questions in final examinations for these chapters are 20% theoretical and 80% of calculation.Then there is chapter four which explains the IC design flow and layout. Basically students need to design various logic diagram from schematic circuit to layout such as NAND gate, NOR gate and Inverter. While chapter five is about introduction to manufacturability and testability.

The crucial part for this course is chapter three. This chapter is about the fabrication process where the overview on IC technology, Moore's Law, very large scale integration (VLSI) technology, metal oxide semiconductor (MOS) transistor, basic chemical fabrication process and IC packaging are learnt. The type of question for this chapter in final examination is 100% theory. The need to memorize all information is the biggest problem. Nevertheless, the apprehensive ability is limited due to in-class method of learning only is practiced instead of real laboratory exposure or site visits.

This paper is aim to identify the effect of having theoretical questions on student performance in final examination and to improve the learning outcome for these type of questions.

2.0 LITERATURE STUDY

Numerous studies have been conducted to identify the factors that influenced students' academic performance. One of the researched factors that affect students' performance is students' engagement in class (Gunuc, 2014; Lei, H., Cui, Y., & Zhou, W. 2018). A study has reported that students' engagement plays major role in determining their average academic performance. Students' engagement in class relates to the effect of students' attitude. Students' attitude can be defined as a measure of their positive and negative feelings toward learning, difficulty and self-efficacy, plus general impression toward the action taken to perform academic excellence (Thurstone, 1970). Students who possess positive attitude toward learning were found to be more committed in their studies while negative students are to be anti-social and completely disengage from learning environment (Awang, Jindal-Snape, & Barber, 2013).

In relation to students' attitude, absenteeism also believed to be the main effect influenced in academic performance and student learning process (Rothman, 2011; Demir, K. & Akman Karabeyoglu, Y., 2016). This finding was correlated with the effects of social support on academic performance. Social support refers to perceived care, support and assistance from other people such as family and peers. Social relationship and support are important aspects of any individual's well-being.

Other than that, factor such as students' prior knowledge in academic achievement has been studied (Ogunleye, Awofala & Adekoya, 2014). The research focusing on the impact of students' background knowledge of mathematics and their physics course performance, but based on the finding there was no statistically significant difference between the experimental (teaching of prerequisite mathematics concepts in physics before real physics teaching) and control (physics teaching only) groups with regards to their achievement in physics.

Effect of lecturer's teaching method in class (Aslam & Kingdon, 2011; Blazar, D., & Kraft, M. A., 2017) also is the one factor that contributes to student performance. Lecturers' teaching method refers to the general principles, pedagogy and management strategies used for the classroom instructions. This method in the class affects the outcome of student acceptance of knowledge transfer. This is supported by past research which stated that teaching is a continuous process involves in bringing the desirable changes in learners to achieve specific outcomes (Ayeni, 2011).

3.0 METHODOLOGY

Introduction to Microelectronics course consist of evaluations in different levels of Bloom's Taxanomy including soft skills, critical thinking, problem solving, technical knowledge and others (Blooms, 1956). The assessment comprise of; i) 2 tests, 30%, ii) assignments, 10% , iii) 2 laboratory reports, 10%, and iv) final examination paper, 50%.

In this paper, the respondents are students whom enrolling the course in previous 3 semesters (2014/2015, 2015/2016 and 2016/2017 session II). In the beginning, data(s) were collected from Result Entry System or also known as RES. RES was used to calculate the overall marks including test, assignment, laboratory report and final examination for each student thus producing the final grade. Then, the collected data(s) from 3 previous semesters were compared. The research flow is summarized in Figure 1 below:

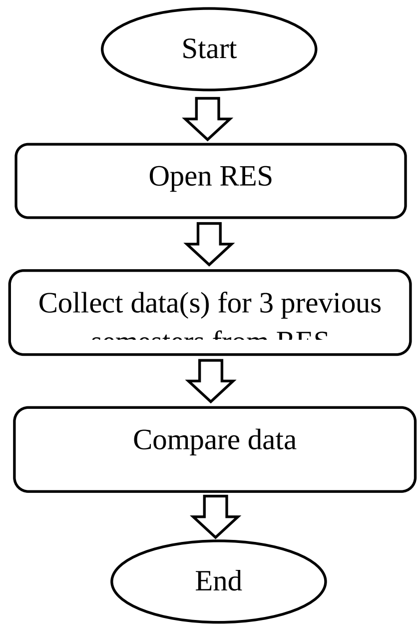

Figure 1. Summary of research flow

In final examination, there are five main questions. Each question represents each chapter and overall marks for each questions was 20 marks. These final examination questions are mainly divided into 3 different types. They are calculation (question 1 and 2), theoretical (question 3) and sketching and designing (question 4 and 5). The collected data(s) will then indicate which types of question the most favorable would be amongst.

4.0 RESULT AND DISCUSSION

The collected data(s) from Result Entry System (RES) for those 3 semesters (2014/2015 session II, 2015/2016 session II and 2016/2017 session II) comprises of more than 60 students per semester. Figure 2, 3 and 4 exhibits the data(s) collected from semester 2014/2015 session II. The total number of students for this semester is 61 with 50 males and 11 females.

Figure 2 below shows the average marks for each question where 20 is the maximum. By referring to this figure, it is revealed that the highest average marks for this semester is question number 4 (sketching and designing); 16.4 and the lowest is question no 1 (calculation) with 8.2 while the second lowest is question number 3 (theoretical) with 11.3. With this figure, it is proved that difficulties extant when answering questions with calculation and theory. On top of that, during 2014/2015, the course was being offered for the first time around UiTM Dungun Campus and the final examination questions has been prepared with no formula appendix.

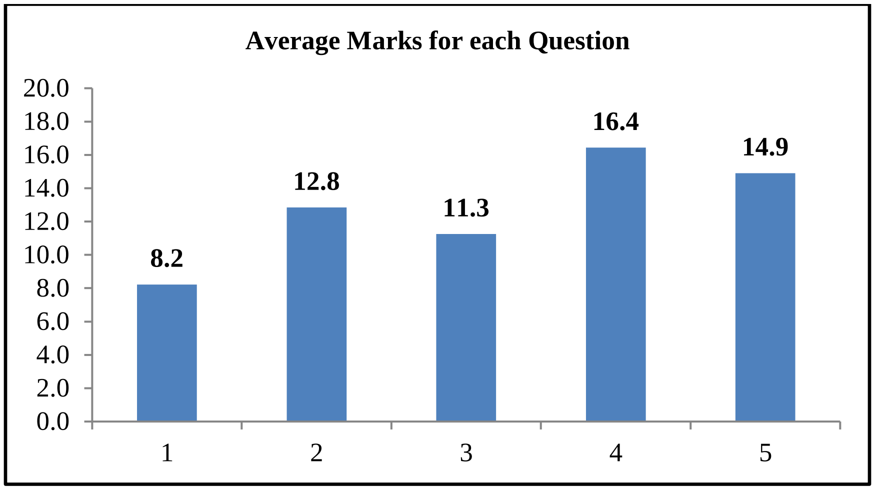

Figure 2. Average marks for question number 1 - 5 for semester 2014/2015 session II

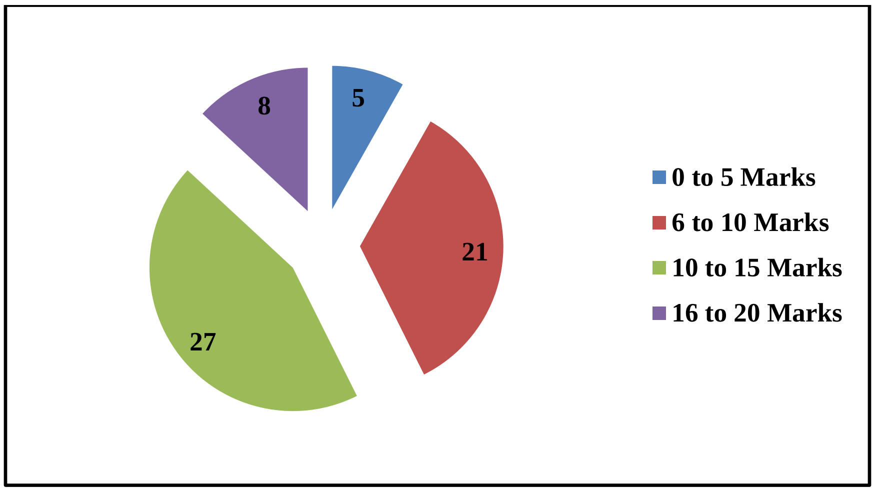

Figure 3. Breakdown of marks for question number 3 for semester 2014/2015 session II

Figure 3 above displays the marks' breakdown for question number 3. Out of 61 students from this semester, 8 students achieved 16 to 20 marks with the highest marks of 17. Average settle down around 10 to 15 marks with 27 students and 6 to 10 marks with 21 students. The remaining 5 students achieved the lowest, 0 to 5 marks.

Figure 4 next page shows the final result for the same semester. From 61 students of this semester, 26.5% (18 students) achieved an A for this subject with 7 solid A and 11 A-. Most students achieved B+, B, and B- contributing to 42.62% of the chart. It also shows that 3 students (4.91%) achieved D and E which considered as failed. In a different research, it appear that those whom achieved D and E scored between 0 to 5 marks for question number 3 (theory), while those whom scored between 16 to 20 contribute to achieved A or A-.

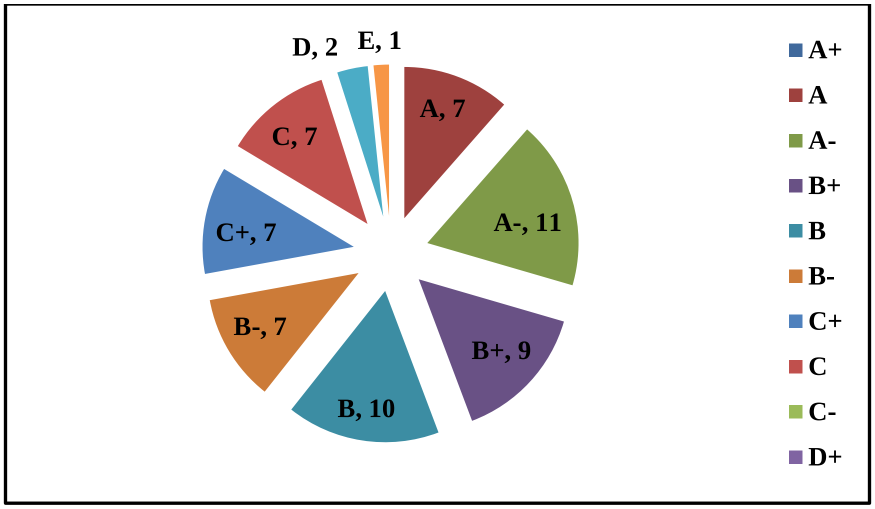

Figure 4. Final result grades chart for semester 2014/2015 session II

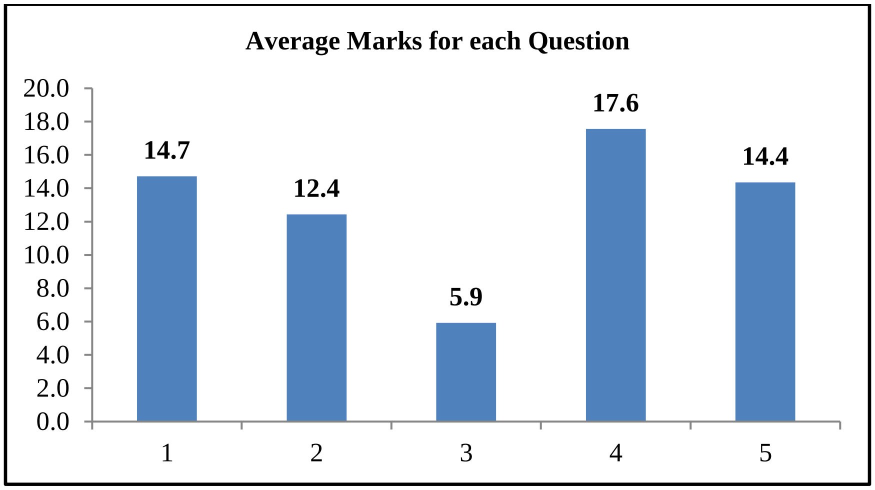

Figure 5. Average marks for question number 1 - 5 for semester 2015/2016 session II

Figure 5 above displays the average marks for question number 1 to 5 for the semester 2015/2016 session II. Total number of students in this semester was 78, with 52 males and 26 females. The graph displays the lowest average marks was question number 3 (theory) with 5.9 marks followed by question number 2 (calculation), 12.9 marks. The highest average marks was question number 4 (sketch and design) with 17.6 marks and it proves once again that question number 4 was favorable among the students. By comparing Figure 5 and Figure 2, it can be seen that the marks for question 1 increased from 8.2 to 14.7. This might explained by the prepared appendix with formulas thus helps in answering well.

Figure 6 below exhibits the breakdown of marks for question number 3. Out of 78 students, only 2 obtained marks from 16 to 20 with the highest is 16. Most settled for marks around 0 to 5 and 6 to 10 with a total of 62 students. The remaining 14 scored 10 to 15 marks.

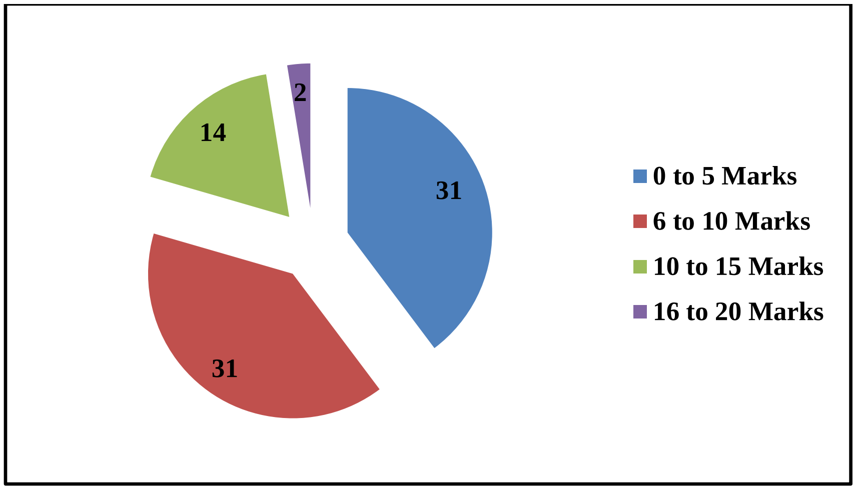

Figure 6. Marks breakdown for question number 3 for semester 2015/2016 session II

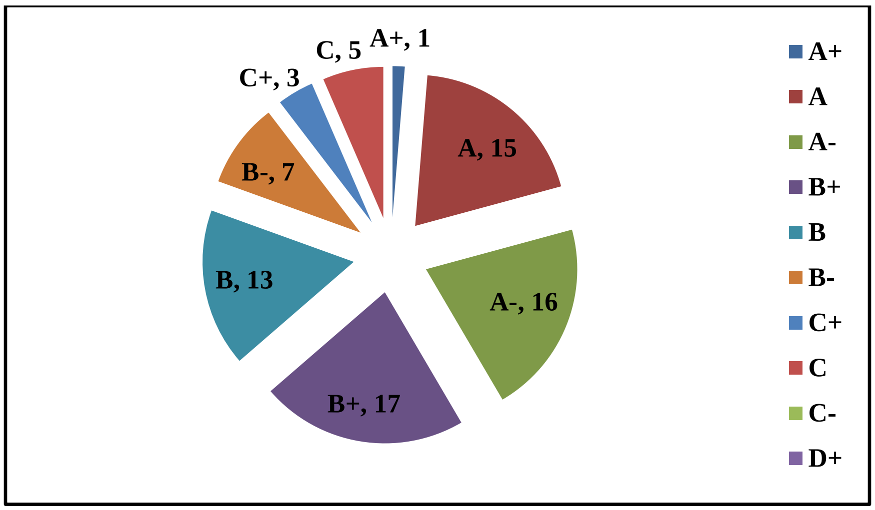

Figure 7. Final result grades chart for semester 2015/2016 session II

Figure 7 above shows the final result for the same semester and session. From 78 students, 41% (32) achieved an A for this subject with 1 A+, 15 solid A and 16 A-. Most whom scored 10 to 20 marks for question number 3 (theory) will be able to achieved an A. By referring to Figure 6 and 7, it is proved again that students failed to answer question number 3 successfully but still managed to achieve an average result with 47.4% (37) of B+, B and B-. The remaining 8 (11.6%) achieved C+ and C.

As seen, the average marks for question number 3 had drastically dropped compared to previous semester. Nevertheless, losses marks from question number 3 are covered with the marks from other questions such as question number 1 and number 2 with the helps from given appendix. This can be proved on Figure 8 where only 10.25% attaination on the lowest grade.

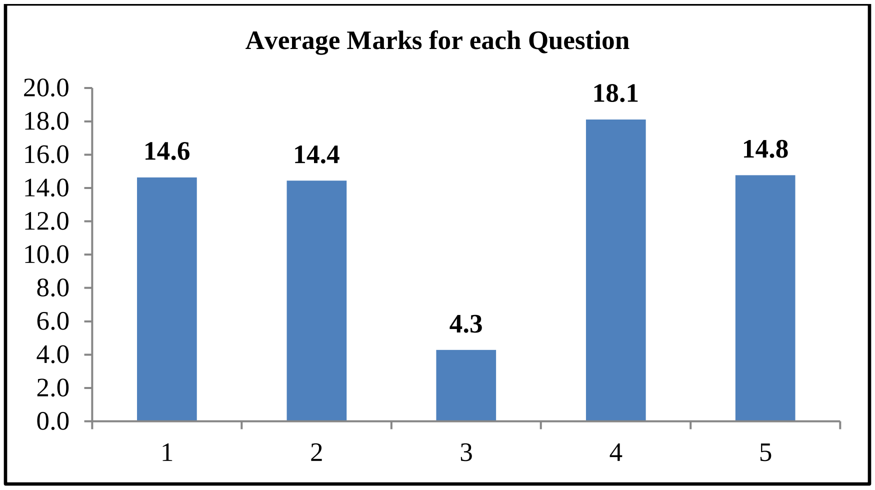

Figure 8. Average marks for question number 1 - 5 for semester 2016/2017 session II

Figure 8 above displays the average marks for question number 1 to 5 for semester 2016/2017 session II. Total number of students for this semester was 60; with 41 males and 19 females. Again, same as previous two semesters, the display indicates that the lowest average marks was still question number 3 (theory) with 4.3 marks. Worse, this semester possess the lowest average marks for question number 3 compare to both previous semesters. As experience before, question 4 (sketch and design) hold the highest average marks with 18.1. On the other hand, question number 1 & 2 (calculation) and 5 accomplished average marks; 14.

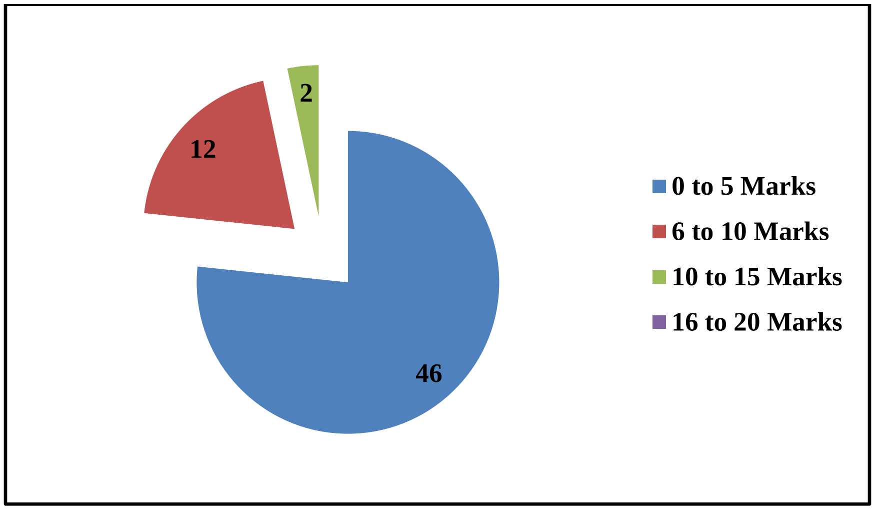

Figure 9. Breakdown of marks for question number 3 for semester 2016/2017 session II

Figure 9 above shows the marks breakdown for question number 3. Out of 60 students, none get 16 to 20 marks and only 2 get 10 to 15 marks. Most obtained marks around 0 to 5 with a staggering number of 46 students. The remaining 12 students scored 6 to 10. The failed numbers around 0 to 5 marks is noticed to have increased compared to the semester of 2015/2016 session II.

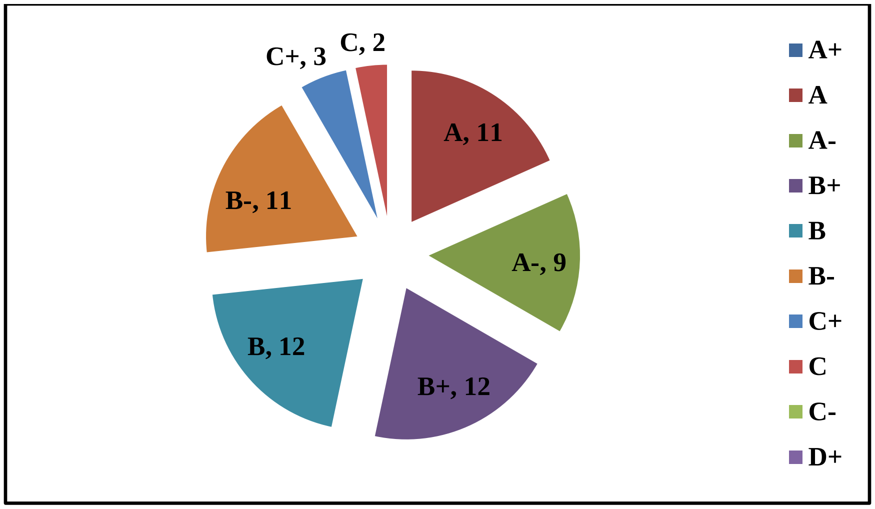

Figure 10. Final result for semester 2016/2017 session II

Figure 10 above exhibits the final result for the same semester. Out of 60, 33.33% or 20 students achieved an A with 11 solid A and 9 A-. 58.33% achieved B with 12 B+ and B respectively, while 11 B-. The remaining 8.33% (5) managed to achieve C.

As can be seen, the average marks for question number 3 once again dropped compared to previous semester. And again, losses marks had been covered with other questions such as question number 1 and number 2 with the helps from appendix. This is exhibits from Figure 10 where only 8.33% settled for the lowest grade. Trend result for this semester is very similar with the previous semesters.

5.0 CONCLUSION AND FUTURE WORKS

Overall, by comparing all three semesters (2014/2015, 2015/2016 and 2016/2017 session II) it shows that the number of students whom did not score the theoretical question; i.e question 3 increased every semester. It is proven that question 3 (theory) was not convenient to be answered compared to question number 1 and 2 (calculation) or question number 4 and 5 (sketch and design). Other than that, it is also proved that question 3's total score affect the final grade. Normally, those whom scored question 3 within 10 to 20 marks will probably obtained an A for final grade.

As a conclusion, this paper explained the collected data(s) from Result Entry Systems (RES) for 3 respective semesters on students whom enrolled in 'Introduction to Microelectronics' course. These data(s) provide information such as number of questions, marks and grade for each student. From the results, it appears that theoretical question was not favorable compared to calculation or design questions. When researched, the reasons is theoretical question was hard to score because most are unable to differentiate the real devices with the theories interpreted in classroom. Even though the knowledge of the fabrication process itself is there; lectured theoretically in classroom, but the hands-on practice is not there. In order to improve the understanding of students in theoretical part, a proposal to develop experimental learning concept is proposed. The learning outcome for this subject can possibly be improved by the implementation of Experiential Learning especially on theoretical part.

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