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Abstract

Psychomotor domain is an essential skill required in any diploma engineering programme where it is empowering students' practical engineering skills ability as a complementary element to the theories that were learned during lectures. Moreover, this learning experience engages the students with the engineering experimental laboratory work. This paper studied the impact of the psychomotor elements in enhancing the cognitive performance of second-year diploma students in a fundamental course, Electronics 1 at the Centre for Electrical Engineering Studies, Universiti Teknologi MARA Cawangan Pulau Pinang, (UiTMCPP), Malaysia. A standard course outline for Electronics 1 is adapted from the Engineering Technology Accreditation Council (ETAC) whereby it underlined the practical skills needed as competent engineering technicians. The data in this paper utilizes the examination results from two semesters as a comparison of students' performance. The online distance learning (ODL) approach was implemented for both semesters, where the laboratory session was conducted in face-to-face (F2F) teaching mode. A practical test was conducted at the end of the semester to assess the student's psychomotor knowledge and skills. The statistical analysis of all data was carried out using the Statistical Package for Social Science (SPSS). The findings of the study using ANOVA and Pearson correlation provide important insight into students' cognitive domain achievement is influenced by the implementation of psychomotor elements and students have better psychomotor skills at the end of the course.

Keywords: Psychomotor Domain, Cognitive Domain, Online Distance Learning (ODL)

Introduction

In Malaysia, the Institute of Higher Learning (IHL) is being facilitated by the Board of Engineers Malaysia (BEM) in ensuring the quality of engineering education programmes that attain the minimum standard requirements through accreditation. Whilst the ETAC is the body delegated by BEM for the accreditation of Engineering Technology and Engineering

Technician education programmes. The graduates of the accredited engineering diploma programmes must satisfy the minimum academic and practical requirements as the main objective of accreditation. Thus, global recognition for excellence in engineering practice as well as educating future leaders can be achieved. The standard in the engineering programme includes elements of outcomes in the engineering technician education programme curriculum to ensure a Continual Quality Improvement (CQI) culture in the spirit of Outcome-Based Education (OBE) (Engineering Technology Accreditation Council, 2020).

Over decades, the OBE growth plays an important approach in higher education teaching and learning where it expresses individual student learning through structured tasks that demonstrate students' skills achievement in three domains: Cognitive, Psychomotor and Affective. Effective from 2020 onwards, all electrical engineering diploma programmes in UiTMCPP have implemented a minimum of 30% for practice-oriented components in the technical and specialist area as part of the qualifying requirements (Engineering Technology Accreditation Council, 2020). Hence, the psychomotor domain has become an important skill in the higher education curriculum nowadays. The psychomotor refers to the physical aspects of learning, in the specific context, it relates to engineering technology practical components; integrated training in professional engineering practice, including management and professional ethics; laboratory work to complement the science, computing and engineering theory.

The psychomotor domain is a motion-based orientation measured to assess the physical skills comprising the motor skill coordination and movement which is believed to evolve over time (Alobaidi, 2020; Isa et al., 2019). According to Noraida Mohd Saim, the psychomotor domain can be classified as a physical component involving the ability to perform a task precisely and easily. This domain is typically related to how to be controlling and handling equipment or tools thus presenting the students' practical skills performance (Saim et al., 2021).

Based on Che Maznah and the co-worker studies, the implementation of programme outcomes (POs) pertaining to study aspects identifies the important characteristics that assist students in achieving psychomotor skills in laboratory courses with most of the final year students strongly agreeing that their psychomotor attainment is carried out effectively by considering several important factors (Isa et al., 2019). Another notable research is to assess students' practical intelligence by identifying semi-complete test kit circuits. The objective of the developed kit instrument is to support the hypothesis that if students repeatedly construct simple circuits during hands-on exercise, their practical intelligence improves in respect of experience and time, and they will be able to construct complicated electrical circuits in actual implementation due to the level of practical intelligence. The results show that there is a correlation between the two and further support the importance of the practical domain to help students' cognitive understanding (Daud et al., 2018).

The curriculum of the Diploma in Electrical Engineering offered at Universiti Teknologi MARA (UiTM) has also been designed to meet all the qualifying requirements as stated in the MQA and ETAC standards. The Programme Outcomes (POs) that focused on a psychomotor domain are; 1) PO4: Investigation- Conduct investigations of well-defined problems; locate and search relevant codes and catalogues, conduct standard tests and measurements; and;

2) PO5: Modern Tool Usage - Apply appropriate techniques, resources, and modern engineering and IT tools to well-defined engineering problems, with an awareness of the limitations.

During the COVID-19 pandemic, the implementation of the Teaching and Learning (TnL) approach evolved from conventional F2F to the online teaching method. Hence, the cognitive and psychomotor TnL delivery method has been aligned to adapt to the new norms, such as online learning, open distance learning, and online assessments to measure performance. As for the students adapting to the change in the online learning environment, they face distinctive challenges especially in comprehending a particular course that is typically taught eye to eye. Certain courses require direct assistance from instructors, therefore maintaining students' enthusiasm, dedication, fulfilling the task assigned as well as their motivation and aptitude to learn independently will be another challenge to the student (De Souza et al., 2021; Hermanto & Srimulyani, 2021). In addition, factors that influence learning barriers during the pandemic are lectures, student engagement, and student-to-student interaction (Azlan et al., 2021).

Psychomotor skills for engineering students become crucial to produce expertise (Baharom et al., 2015). Therefore, the number of laboratory experiments in psychomotor implementation must be sufficient and meet the practice-oriented criteria in the execution of psychomotor so that students' preparedness in the working environment is adequate per the accreditation standard (Mat Isa et al., 2020). After having the opportunity to acquire and practice hands-on skills, the students can refine and interpret theoretical concepts as an effective method to understand the course (Salim et al., 2012).

Adaptation of lab experiments and appropriate assessments definitely will contribute significantly to enhancing student performance, provided students know how to integrate theories (cognitive domain) and implementation (psychomotor domain) in the laboratory as well as the correlation between them. It is crucial, especially for electrical engineering courses, which in general are based on practical-oriented as early exposure to students before moving into the industry (Salim et al., 2012). Thus, the objective of this paper is to study the impact of the psychomotor domain on cognitive performance in Electronics 1.

This paper is organized as follows in which this Introduction section explains the teaching and learning approach from the conventional F2F to online teaching methods including the previous research papers, journals and studies. It serves as a guide for the writer when writing a solid literature review. Secondly, the next section of this paper is Methodology. The methodology is divided into data collection and statistical analysis. The data for such work contains the results of all students enrolling in this course from two different semesters as a comparison of students' achievements is presented in section Results. The ODL approach was implemented for both semesters except for F2F teaching methods during the lab session. The last section of this paper is the Conclusion. It will summarize the results obtained from this finding and conclude with the psychomotor effects of the course.

Methodology

A. Data Collection

Electronics 1 is a compulsory course offered in semester three for Diploma in Electrical Engineering (Electronics). The course introduces the fundamentals of semiconductor materials, operating concepts and characteristics of electronic devices such as a diode, Bipolar Junction Transistor (BJT) and Metal Oxide Semiconductor Field Effect Transistor (MOSFET). Previously, the performance of this course was measured under a cognitive domain and an affective domain. However, starting in September 2020, Electronics 1 was assessed for the cognitive domain and psychomotor domain, in line with the requirement of practice-oriented components as outlined by the Engineering Technician Education Programme Accreditation Standard.

Course Outcomes (COs) is the statement of objective to be achieved by the students at the end of a semester. Table 1 displays the differences in COs before and after the ETAC-reviewed syllabus was implemented. Both CO1 and CO2 are referring to the cognitive domain for both sessions, where the most significant difference is in CO3. Currently, CO3 is measured in the psychomotor domain instead of the affective domain in the previous syllabus.

Table 1
Changes of Course Outcomes (COs) after ETAC-reviewed syllabus

	Session 1 2020/2021 (Before ETAC)	Session 1 2021/2022 (After ETAC)
CO1	Explain the basic solid-state concepts of electronic devices. (Cognitive)	Discuss the basic solid-state concepts of semiconductor material and diode. (Cognitive)
CO2	Analyze the parameters of single-stage transistor amplifiers in DC and AC domains and diodes in different applications. (Cognitive)	Analyze DC and AC single-stage transistor amplifiers in different applications. (Cognitive)
CO3	Discuss the characteristics, configuration and operation of electronic devices through written communication. (Affective)	Construct basic electronic circuits using simulation software and/or experimental. (Psychomotor)

Table 2 presents the course evaluation for both sessions to display the changes after the latest review syllabus. Noticed that, the new syllabus comprised 30% psychomotor domain and 70% cognitive domain. The assessment of the psychomotor domain is then further divided into laboratory work, 20% and laboratory test, 10%. The psychomotor assessments were individually evaluated.

Table 2
Comparison of Course Evaluation

Session 1 2020/2021 (Before ETAC)		Session 1 2021/2022 (After ETAC)	
Tests (2)	30%	Tests (2)	20%
Assignment	10%	Laboratory Work	20%
		Laboratory Test	10%
Final Examination	60%	Final Examination	50%

The data of this study originated from the Electronics 1 examination results of two different sessions, namely in this paper as session 1 2020/2021 semester October 2020 – February 2021 (before the ETAC-reviewed syllabus was implemented) and session 1 2021/2022 semester October 2021 – February 2022 (after the ETAC-reviewed syllabus was implemented) at UiTMCPP. Table 3 displays the measured variables for this study to see the impact of psychomotor domain existence on cognitive domain attainment. Both groups of students were learning through ODL due to the pandemic Covid-19. Hence, it presented a like-for-like comparison.

Table 3
Measured Variables

Session	Number of registered students	Measured variables
Session 1 2020/2021 (Before ETAC)	42	Cognitive
Session 1 2021/2022 (After ETAC)	39	Cognitive and Psychomotor

The laboratory work introduced after the ETAC-reviewed syllabus contains six modules taken from the syllabus content. Table 4 tabulates the modules and related chapters to correlate the psychomotor and cognitive elements. The learning process starts with the knowledge acquired during lectures (cognitive) and thereupon students are capable of conducting laboratory work (psychomotor). This learning method is expected for the students to grasp both cognitive and psychomotor. After completing all six modules, the laboratory test will be conducted to evaluate their hands-on skills. Both the laboratory work and laboratory tests will be focused on evaluating the student's ability to conduct experiments and handle the equipment and data collection.

Table 4
Laboratory modules versus syllabus content

Chapter 2: Diode	
Module 1	Diode Application: Clipper
Module 2	Diode Application: Clamper and Voltage Multiplier
Module 3	Diode Application: Rectifier and Voltage Regulator
Chapter 3: Single Stage Bipolar Junction Transistor (BJT)	
Module 4	DC Analysis of Single Stage Bipolar Junction Transistor Amplifier
Module 5	AC Analysis of Single Stage Bipolar Junction Transistor Amplifier
Chapter 4: Single Stage Metal Oxide Semiconductor Field Effect Transistor (MOSFET)	
Module 6	Metal Oxide Semiconductor Field Effect Transistor Transfer-Characteristic Curve

B. Statistical Analysis

The statistical analysis of all data was carried out using the Statistical Package for Social Science (SPSS). Two methods of statistical analysis were conducted, which are ANOVA and Correlation analysis. A one-way Analysis of Variant (ANOVA) test was done to observe the significant difference of psychomotor elements in influencing cognitive achievements in both sessions. The obtained p-value from ANOVA analysis will indicate either to reject the null hypothesis or to accept the alternative hypothesis.

For further analysis, the Pearson correlation analysis is used to describe the relationship between the cognitive domain and psychomotor domain during session 1 2021/2022. Finally, the mean value between the cognitive and psychomotor domains was studied to find which domain is slightly dominant.

Results

A. Course Outcomes Attainment

The overall achievement of CO attainment for both sessions is illustrated in Figure 1. As presented, all COs for session 1 2021/2022 have achieved the minimum Key Performance Indicators (KPI) target set by the school which is 65%. While in the other session, the CO attainment is slightly lower than the set KPI. Both CO1 and CO2 which represent the cognitive domain improve from 61% to 67.9% and 61% to 67%, respectively. This produces an increase of 11.31% for CO1 and 9.34% for CO2 as stated in Table 5. Consequently, the addition of psychomotor element (CO3) in session 1 2021/2022, helped in the attainment of the cognitive outcomes and the CO3 attainment also presents a good result of 76.5%. This result is consistent with the study by Rahman et al., 2020 who state that psychomotor and cognitive domain are important to determine the success of students.

Table 5
Percentage of increment in cognitive Course Outcomes

Course Outcome (Cognitive)	Percentage of increment (%)
CO1	11.31
CO2	9.84

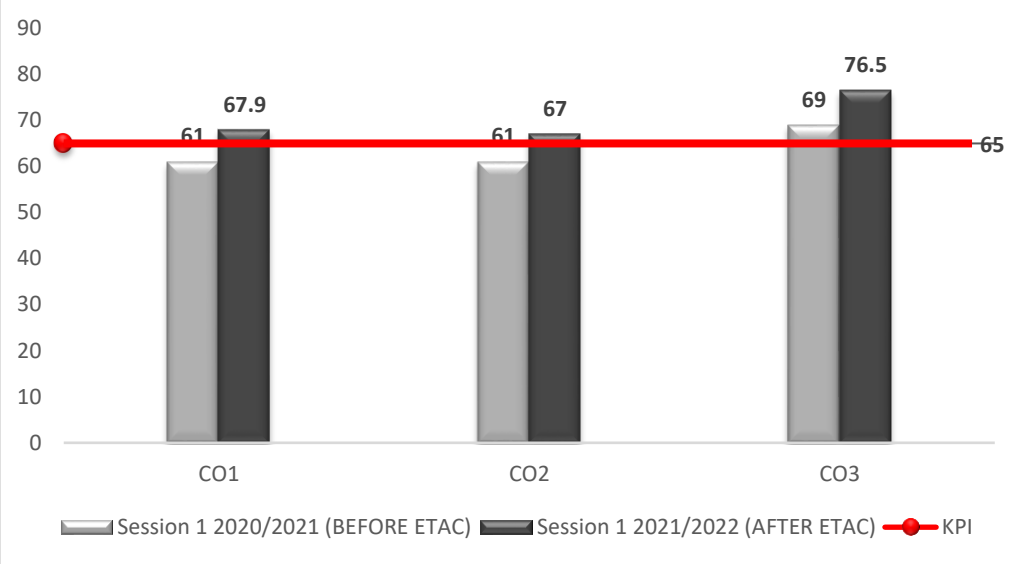

Figure 1: Comparison of CO attainment for session 1 2020/2021 and session 1 2021/2022

B. Statistical Analysis Result

The statistical analysis compares the means between the two sessions. In this paper, the null and alternative hypothesis are as follow:

Null Hypothesis, H_o: There is no difference in cognitive value between two sessions
Alternative Hypothesis, H_a: There is a difference in cognitive value between two sessions

Based on the one-way ANOVA analysis, the result of F (1,79) = 9.63 and p-value = 0.03. It appears that the p-value is less than the level of significance, 0.05. Therefore, the null analysis is rejected. The test indicated that there is a significant difference, which means the students' cognitive domain achievement is influenced by the implementation of psychomotor elements.

Since the p-value shows a significant difference, additional analysis is done to study the correlation between the cognitive domain and psychomotor domain in session 1 2021/2022. The result is presented in Table 6. It has been found that the significant value is 0.004 and positive correlation of 0.447. This value reflects that the cognitive domain and the psychomotor domain are statistically correlated due to the significant value being less than 0.05 and the strength of the correlation is medium since the value is within $0.3 < r < 0.49$ (Cohen, 1998).

Table 6
Correlation Result Between Domains

		Psychomotor Domain
Cognitive Domain	Pearson Correlation	0.447
	Sig. (2-tailed)	0.004
	N	39

In addition, Table 7 shows the mean value in percentage for the cognitive and psychomotor domain of session 1 2021/2022 students. The highest mean percentage is the psychomotor domain followed by the cognitive domain with the mean value of 73.51 ± 12.83 and 67.41 ± 18.80. The highest mean value indicates that the students have better psychomotor skills. This situation is in line with the findings by Jainudin, 2021.

Table 7
Mean Value for Domains in Percentage

	No of samples, N	Mean, μ (percentage)	Std. Deviation
Cognitive Domain	39	67.41	18.80
Psychomotor Domain	39	73.51	12.83

Conclusion

The contribution of this research focuses more on revealing the impact of the psychomotor elements in enhancing the knowledge and performance of Electronics 1. The student's performance was investigated by evaluating both the cognitive and psychomotor domains throughout the chosen sessions. The result shows students' cognitive domain achievement is influenced by the implementation of psychomotor elements and students have better psychomotor skills at the end of the course. In a nutshell, incorporating the laboratory element and practical assessments establishes the psychomotor quality where students have successfully improved their theoretical comprehension, analysis, and practical skills. This valuable relevant learning experience will benefit graduates specifically dealing with the challenging work environment as an engineer one day. Moreover, further investigation on this impact is planned to be done by increasing the number of sessions in the future. In addition, the study on psychomotor module achievement is also meant to be done to see the effectiveness of the psychomotor domain attainment for this subject.

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References

Engineering Technology Accreditation Council. (2020). Engineering Technician Education Programme Accreditation Standard 2020. In *Engineering Accreditation Council* (Issue May).

Baharom, S., Khoiry, M. A., Hamid, R., Mutalib, A. A., & Hamzah, N. (2015). Assessment of psychomotor domain in a problem-based concrete laboratory. *Journal of Engineering Science and Technology*, *10*(Spec. Issue 1 on UKM Teaching and Learning Congress 2013, June 2015), 1–10.

De Souza, N., Ochotorena, M., Self, B. P., & Cooper, L. A. (2021). Sudden Shift to Online Learning: COVID-19's Impact on Engineering Student Experiences. *ASEE Annual Conference and Exposition, Conference Proceedings*.

Hermanto, Y. B., & Srimulyani, V. A. (2021). The challenges of online learning during the covid-19 pandemic. *Jurnal Pendidikan Dan Pengajaran, 54*(1), 46-57.

Azlan, K. N. A., Azman, R. A., Azman, W. M. W. N. A., & Mohi, Z. (2021). Students' Experiences towards Open and Distance Learning (ODL) Service Quality in UiTM Puncak Alam. *Journal of Tourism, Hospitality & Culinary Arts*, *13*(2), 127–155.

Saim, N. M., Noor, N. A. M., Alias, R., & Rosli, S. H. (2021). Evaluation of Programme Outcomes Under the Psychomotor and Affective Domain for Diploma Civil Engineering Students Through Industrial Training: A Statistical Study from Employers' Perspective in Malaysia. *International Journal of Engineering Pedagogy, 11*(5).

Jainudin, N. A., Openg, I., Nazaruddin, A., Matarul, J., & Neging, M. (2021). Evaluation of Undergraduate Students in Construction and Project Management Course in Term of Cognitive, Psychomotor & Affective Domain: A Case Study on Civil Engineering Students in UiTM Sarawak, Malaysia. *International Journal of Advanced Research in Education and Society*, 3(2), 168-173.

Mohamad, M., Lian, O. C., Zain, M. R. M., Yunus, B. M., & Sidek, N. H. (2021). Student Attainment Measurement System in Civil Engineering Undergraduate Programme: A Satisfaction Survey. *Asian Journal of University Education*, 17(2), 191-202.

Rahman, M. H., Iriani, T., & Widiasanti, I. (2020). The Analysis of Cognitive and Psychomotor Domains in Basic Competence in the Subject of Land Measurement Engineering in Curriculum Vocational Schools-Area of Expertise Construction and Property. *KnE Social Sciences*, 186-193.

Isa, C. M., Mustaffa, N. K., Joseph, E. O., & Preece, C. N. (2020). Development of Psychomotor Skill and Programme Outcome Attainment of Civil Engineering Students in Malaysia. *Asian Journal of Vocational Education and Humanities, 1*(2), 9-24.

Noor, N. A. M., Saim, N. M., Alias, R., & Rosli, S. H. (2020). Students' performance on cognitive, psychomotor and affective domain in the course outcome for embedded course. *Universal Journal of Educational Research, 8*(8), 3469-3474.

Alobaidi, A. H. (2020). Assessment of the Psychomotor Domain: Medical Education. *INTERNATIONAL JOURNAL OF MEDICAL SCIENCES, 3*(2), 105-141.

Isa, C. M. M., Joseph, E. O., Saman, H. M., Jan, J., Tahir, W., & Mukri, M. (2019). Attainment of Program Outcomes under Psychomotor Domain for Civil Engineering Undergraduate Students. *International Journal of Academic Research in Business and Social Sciences, 9*(13), 107-122.

Ahmad, A., Kamin, Y., & Nasir, A. M. (2018). Applying psychomotor domain for competency based teaching in vocational education. In *Journal of Physics: Conference Series* (Vol. 1049, No. 1, p. 012049). IOP Publishing.

Daud, M. H., Razali, Z. B., & Kader, M. M. M. A. (2018). Effective ways to test changes of practical intelligence in order to assess unintentional learning in laboratory classes. In *MATEC Web of Conferences* (Vol. 150, p. 05003). EDP Sciences.

Viscione, I., D'Elia, F., Vastola, R., & Sibilio, M. (2017). Psychomotor Assessment in Teaching and Educational Research. *Athens Journal of Education*, 4(2), 169-177.

Hussain, W., Mak, F. K., & Addas, M. F. (2016). Engineering program evaluations based on automated measurement of performance indicators data classified into cognitive, affective, and psychomotor learning domains of the revised bloom's taxonomy. In *2016 ASEE Annual Conference & Exposition*.

Hoque, M. E. (2016). Three domains of learning: Cognitive, affective and psychomotor. *The Journal of EFL Education and Research*, 2(2), 45-52.

Salim, K. R., Haron, H. N., Hussain, N. H., & Ali, R. (2013). The achievement of laboratory work learning outcomes: students' perceptions. *Proceedings of the Research in Engineering Education Symposium* (pp. 1-6).

Karim, N. A. H. A., & Yin, K. Y. (2013). Outcome-based education: an approach for teaching and learning development. *Journal of Research, Policy & Practice of Teachers and Teacher Education*, 3(1), 26-35.

Salim, K. R., Puteh, M., & Daud, S. M. (2012). Assessing students' practical skills in basic electronic laboratory based on psychomotor domain model. *Procedia-Social and Behavioral Sciences, 56*, 546-555.

Cohen, J. (1998). *Statistical Power Analysis for the Behavioral Sciences*. Routledge.