

Perceived Cognitive and Affective Learning and Their Correlations with Student's SPM Grades and Entrance Qualification: A Case Study of an Engineering Mathematical Course

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Received 7 October 2024, Received in revised form 15 December 2024

Accepted 15 January 2025, Available online 30 August 2025

ABSTRACT

Developing strong mathematical proficiency is paramount for engineering students' success. This study evaluates students' perception of learning mathematics and examines how entry qualifications and previous math achievement (SPM mathematics grades) influence students' perceptions of cognitive and affective learning in a Signals and Systems course. A survey questionnaire that collects perceptions of cognitive and affective learning was administered to 113 students enrolled in the course. Descriptive statistics revealed that over 80% of students reported confidence in organizing course materials (C1) and self-directed learning (C4). However, only around 28.5% felt confident creating a study guide (C2), and 31.4% expressed confidence in demonstrating their knowledge to others (C3). Notably, over 80% of students reported positive changes in attitude (A1), increased self-reliance (A2), and active engagement in learning (A3). The Kruskal-Wallis test indicated a statistically significant influence of entry qualifications on students' perceptions ($p < .05$). Students with UiTM diplomas displayed a stronger self-perception in knowledge organizing skills than those with Matriculation or other qualifications. This effect was more pervasive for affective responses ($p < .05$), with UiTM diploma holders reporting significantly more positive changes in attitude, self-reliance, and engagement compared to their peers. Conversely, Spearman's rank correlation coefficient did not reveal any significant associations between SPM mathematics grades and perceived learning abilities (all $p > .05$). These findings emphasize the importance of considering students' entry qualifications in educational design and practice, as these backgrounds can influence students' learning experiences and outcomes.

Keywords: Perceived cognitive; perceived affective; demographics; mathematics course; Spearman's rank correlation; entrance characteristics

INTRODUCTION

The field of engineering and technology (ET) is built upon the fundamentals of mathematics and sciences. Many of the courses in an ET undergraduate program, such as thermodynamics, signal processing, control systems, static and dynamics, structural analysis, etc., require mathematics proficiency. Hence, proficiency in mathematics empowers aspiring engineers and technologists to comprehend, analyze, and manipulate complex concepts, laying the groundwork for designing and implementing engineering solutions.

Throughout the decade, factors affecting students' achievement in mathematics have been studied from various angles. According to a review of 26 publications by Aye bale et al. (Aye bale et al. 2020), teaching strategies, instructors' attitudes, and students' attitudes toward mathematics were some common variables that impacted students' performance in mathematics. The authors also mentioned other elements that may impact pupils' arithmetic ability, including gender-related variables, classroom environment, parental influence, and prior math proficiency. Tang et al. (Tang & Tran 2023) used partial least squares structural equation modelling to show that

parental expectations and participation positively affect mathematics achievement (PLS-SEM). According to descriptive polls (Cruz & Natividad Jr 2022; Oginni 2021; Pawitra & Wulandari 2021; Wahyu et al. 2022), parent involvement and roles have a big impact on how well kids do in math. Other studies examine how the classroom environment, including the size of the class, the instructional materials (Ndidi & Effiong 2020), the quality of interactions (Wang et al. 2020), and cooperative learning (Izamarlina et al. 2024) all directly affect how well kids perform in mathematics. Students' attitudes toward mathematics, involvement in the learning process, and use of technology were examined by Brezavšček et al. (Brezavšček et al. 2020). Structural Equation Modeling (SEM) was used to analyze data gathered over seven academic years. The results showed a very high coefficient of determination (0.801) for mathematics achievement, meaning that the variables together account for 80.1 percent of the variance in mathematics achievement. These variables include perceived levels of math anxiety, self-engagement in math courses at university, and perceived usefulness of technology in math learning. In other work, cross-sectional survey research on selected secondary schools revealed that students' poor performance in mathematics is due to mathematics phobia. The authors recommended reviewing and amending the mathematics curriculum to reduce the fear of learning (Chand et al. 2021). Researchers (Lee et al. 2023) examined student and school factors influencing the affective mathematics engagement of students (students' attitudes). Hierarchical Linear Modeling (HLM) was applied to data collected from 10,221 students from 246 schools. School economic disadvantage status explained 5.3%; students demographic factors explained 1.2%, whereas gender, home language, and immigration status contributed 0.7% of the variance in affective mathematics engagement.

Numerous academics have investigated how students' demographics affect their performance in math-related courses in addition to the previously mentioned. Prior research has examined the influence of demographic traits on academic achievement in both face-to-face (F2F) and distance learning (DL) (A. El Refae et al. 2021; Alghamdi et al. 2020; Zhao & Abuizam 2015). Refae et al. (2021) studied the impact of demographics such as gender, language, and status (i.e., students' seniority) on F2F and DL. It was reported that these demographic characteristics significantly impacted students' academic performance (i.e., grade point average (GPA)) and predicted at least a 7.4% variation in F2F learning and DL. Gabales et al. (2022) attempted to establish a relationship between students' level of mathematics performance in DL based on GPA and their demographics, such as age, gender, family income, and parents' educational background. The

student's age and father's educational background significantly correlate to the student's performance. In addition to demographics, the authors also studied the student's DL experience, such as their access to e-learning resources and their perception of DL (Gabales et al. 2022). A study in (Osadebe & Oghomena, 2018) proved that gender and socio-economic status contributed to students' performance in Mathematics using multiple regression analysis. Rashid et al. (A Rashid et al. 2021) investigated gender performance in mathematics among students at Universiti Teknologi MARA in Terengganu, Malaysia. Descriptive analysis, independent T-test, and Spearman Rank Correlation on the data collected via survey questionnaire show no significant difference in students' mathematics achievement between genders. A study conducted by (Musimenta et al. 2020) using qualitative and quantitative methods concurred with (A Rashid et al. 2021) that gender does not affect mathematic performance. Assumptions about gender differences in academic subjects are unfounded (Musimenta et al. 2020). It can be observed that some research shows a direct influence of demographics on students' performance, whereas some other research presents contrasting findings.

Students' demographics directly correlate with their academic performance; it has been used with other factors such as personality traits, socio-economic, and other environmental factors to predict their final academic performance (Bilal et al. 2022; Kotsiantis, 2012). In (Bilal et al. 2022), pre-admission academic achievements, demographics, and first-semester performance were used to predict the final semester performance of students undertaking the Doctor of Veterinary Medicine. Five prediction models were implemented where the support vector machine demonstrated the best performance at 92% accuracy. At the subject level, the authors (Kotsiantis, 2012) predicted the marks of the Introduction to Informatics module offered at Hellenic Open University, Greece, using demographic features and variables (age, sex, occupation, etc.), assignment marks, and face-to-face meetings.

Based on the literature, students' mathematics performance can be due to parental influence, prior mathematics proficiency, economic status, classroom environment, psychological state, and demographics. For example, researchers have shown that a student's demographics directly affect their academic performance and competency in mathematics from various aspects (A Rashid et al. 2021; A. El Refae et al. 2021; Alghamdi et al. 2020; Gabales et al. 2022; Musimenta et al. 2020; Osadebe & Oghomena 2018; Zhao & Abuizam 2015). Demographic features were also used together with other factors to predict students' academic performance (Bilal et al. 2022; Kotsiantis 2012). However, most studies correlate these factors with students' academic achievement.

Recently, it was reported that students' academic performance could be measured using perceived cognitive, affective, and psychomotor (CAP) (Ab Rahim et al.; Sim et al. 2023). Perceived CAP measures how much students learn from the student's viewpoint, independent of course content and academic grades or achievement (Rovai et al. 2009). Perceived CAP was implemented to evaluate university courses (Carpenter-Horning, 2018; Kawasaki et al. 2021; Rachmawati et al. 2019; Ab. Rahim et al. 2023). However, no study has been conducted to draw a correlation between student entrance characteristics and perceived CAP, particularly in mathematical-related courses. It is significant to study the impact of students' entrance characteristics on their perception of how much they have learned in a mathematics course. This type of study analyzes learning from student perception and excludes grades that may not reflect what students learned, where grading is constrained by institution, course content, and inconsistencies of instructors (Rovai et al. 2009). Therefore, this research aims to evaluate university students perceived learning and investigate the effects of students' entrance characteristics on their perception of learning in a mathematics course from cognitive and affective (CA) points of view. The outcome of this study will reveal the use of perceived CA in assessing student learning abilities and the effect of entrance characteristics such as SPM mathematics grade and entry qualifications on the perceived cognitive and affective skills in mathematical courses.

METHODOLOGY

DATA SAMPLING

An online survey questionnaire (explained in the next subsection) was developed and deployed to 113 students in the EE241 Electronics Engineering and EE242 Electrical Engineering degree program at the School of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, Malaysia. These students enrolled for the Signals and System course (ESE461) during the Semester of March-August 2022. The online survey was emailed to all 113 students in July 2022. Participation in the survey is anonymous and voluntary. The survey questionnaire is explained in the next subsection.

Table 1 provides information about the Signals and System (ESE461) course, such as duration, contact hours, delivery, and assessment methods. The course is compulsory for all semester two students and was delivered face-to-face over 14 weeks (4 contact hours a week)—the course content deals with basic concepts of linear systems. Students were introduced to the fundamentals of signals and systems. Students learned how to apply the Fourier Series to describe and analyze signals. Students were also taught to solve linear differential equations using time-domain and Laplace transformation methods.

DATA COLLECTION INSTRUMENT

Table 2 shows the close-ended survey questionnaire consisting of cognitive and affective (CA) questions adapted and improvised from (Rovai et al. 2009; Sim et al. 2023). These survey questions have been previously used and validated by Ng et al. (2023), who studied perception in learning in an online distance learning course. Psychomotor questions were excluded as the course did not involve any hands-on skills. The first four questions address perceived cognitive learning, whereas questions 5 to 7 address perceived affective learning. Basic demographic questions such as gender, entrance qualification, and mathematics grades obtained in their SPM examination were added.

The data collected from the survey questionnaire is stored securely in Google Drive, which requires secure access. All the questions required a response; thus, the data has no outliers. Confidence interval and margin of error are calculated to ensure that the data obtained and the estimation of the location of a statistical parameter were true for the population (Taherdoost, 2017). Cronbach alpha analysis is conducted to obtain the internal consistency and reliability of the data collection instrument.

Referring to Figure 1, descriptive statistics is used to analyze data collected for questions C1, C2, C3, C4, A1, A2, and A3, respectively, where the scope of this research only studies the perceived CA learning of the students. The median, lower, and upper quartile are calculated for each item C1 to A3. The distribution of responses, i.e. (percentage (%)) that agree, disagree, is plotted to analyze the breakdown of responses of the students based on the Likert scale.

TABLE 1. Course information

Item	Description
Course name (code)	Signals and Systems (ESE 461)
Course duration	14 weeks
Semester	Semester 2
Contact hours	4 hours per week (3 hours lecture, 1-hour tutorial)
Delivery method	Face-to-face classroom
Assessment method	Tests, assignments, and final examination
Content	Introduction to Signals and Systems; Fourier Series; Linear Differential Equations; and Laplace Transform

TABLE 2. Survey questionnaire

Scope	Items Description	Source
C	C1. I can organize course material into a logical structure.	Adapted (Rovai et al. 2009)
C	C2. I cannot produce a course study guide (compilation of personal notes, exercises, and learning activities) for future students.	Adapted and improvised (Rovai et al. 2009)
C	C3. I cannot demonstrate to others the numerical knowledge and skills learned in this course.	Adapted and improvised (Rovai et al. 2009)
C	C4. I can self-learn, critique the lessons, and apply the mathematical skills learned in this course.	Adapted and improvised (Rovai et al. 2009)
A	A1. I have changed my attitude (positive attitude) about the course subject matter due to this course.	Adapted (Rovai et al. 2009)
A	A2. I feel more self-reliant as a result of the content learned in this course.	Adapted (Rovai et al. 2009)
A	A3. I am actively involved in the online learning, i.e., attending all classes/learning activities, paying attention, asking questions, and answering questions posed by the instructor	Adapted and improvised (Sim et al. 2023)

*C- Cognitive, A- Affective

DATA HANDLING AND ANALYSIS

The Kruskal-Wallis test assesses the variations in students' perceptions of cognitive and affective abilities, distinguished by different entry qualifications. This non-parametric test is particularly apt for data that do not meet the normal distribution criterion, making it suitable for analyzing ordinal data derived from Likert scales. The independent variable in this analysis is the entry qualification, while the dependent variable is the perception of cognitive abilities, as measured through four distinct cognitive questions (C1, C2, C3, C4), and affective abilities, as measured in (A1, A2, and A3) based on a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Spearman's rank correlation coefficient, often denoted by the Greek letter ρ (rho), is a statistical measure that assesses the strength and direction of association between two ranked variables. It is a non-parametric measure that does not assume any specific data distribution. Hence, it is well suited in this work to evaluate possible correlations between students' SPM mathematics grades with perceived cognitive and affective abilities, respectively. It also analyzes correlations within and across the perceived cognitive and affective abilities.

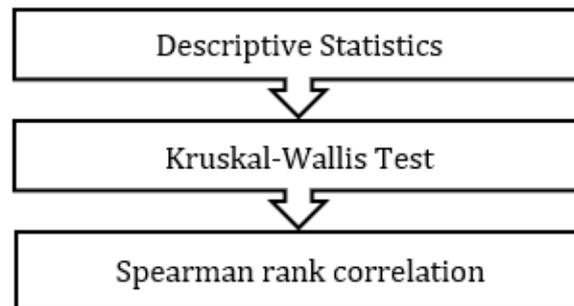


FIGURE 1. Data analysis methods

RESULTS AND DISCUSSION

INTERNAL CONSISTENCY

A total of 107 out of the 113 students responded to the survey; however, two did not agree with their data being analyzed, which leaves the final sample size of 105. Raosoft, an online sample size calculator, suggests a minimum sample size of 88 to achieve a 5% margin of error with a 95% confidence level. Since the final sample

size of 105 exceeds the recommended minimum, this suggests that the sample is sufficient to provide reliable results for the analysis. The global Cronbach Alpha for Cognitive and Affective items is 0.718, indicating that the data collection instrument demonstrates acceptable internal consistency and reliability for the cognitive and affective items.

RESULTS OF DESCRIPTIVE STATISTICS

This section presents the results of the descriptive statistics on the perceived CA. Figure 2 shows the percentage and the number of students n who responded to item C1 based on the Likert scale. Approximately 82% of the students (86 students) strongly agree/agree that they could organize their course material into a logical structure, whereas 18% (19 students) were unsure. It can be said that the majority of the students could organize their learning in a systematic and structured manner. This is supported by the results in Table 3, which show a median value of 4 where most students agree with C1 and displayed a high level of consensus at level 4 with an interquartile range (IQR) of 1.

The results shown in Figure 3 further scrutinize the ability of the students to organize their learning based on their ability to document the information and knowledge

learned in the form of a study guide or personal notes. Though 82% of the students were confident they could organize course material in item C1, only 28.5% who strongly disagree/disagree with item C2 in Figure 2 indicated they were confident in producing a course study guide that can be used personally and as a reference for future students. On the other hand, 40% of the students indicated an inability to produce such a study guide. According to Table 3, an IQR of 1 for item C2 displayed moderate variability around the median level of 3.

The following graph in Figure 4 shows the distribution of students' perception of item C3: 'I cannot demonstrate to others the numerical knowledge and skills learned in this course'. The graph in Figure 4 demonstrated a fairly distributed response variability in perceptions in the central 50% of the data around the median level of 3 (see Table 3). Around 31.4% (strongly disagree/disagree) indicated that they could demonstrate their knowledge and skills to others, whereas 29.6% of the students indicated that they could not demonstrate their mathematical skills. It was observed that the number of students who could demonstrate knowledge and skills to others closely agrees with those who could produce a course study guide. Scale 3 contributed to 39% of the students unsure whether they could demonstrate their knowledge and skills to others.

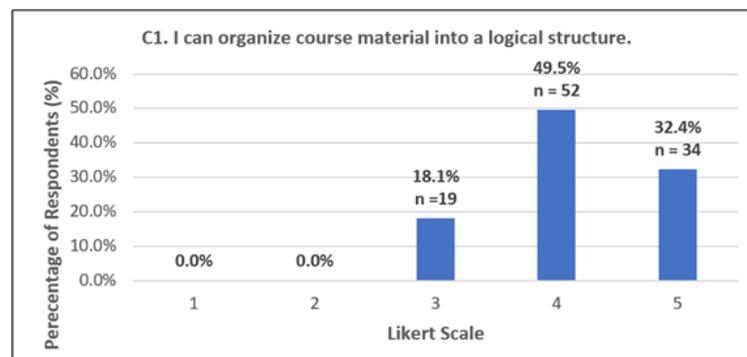


FIGURE 2. Percentage of respondents for item C1

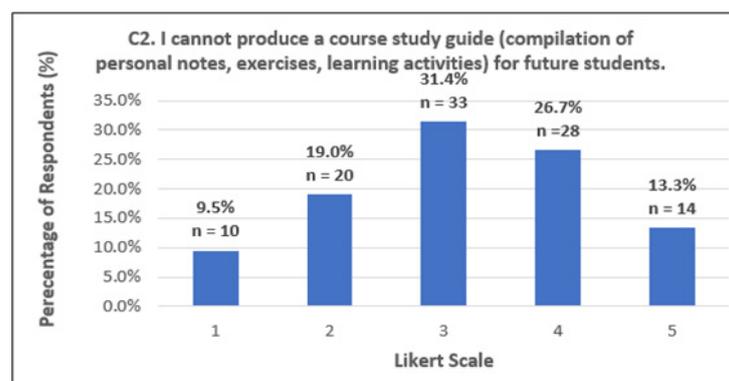


FIGURE 3. Percentage of respondents for item C2

TABLE 3. Median and Interquartile Range (IQR) of Items

Items Description	Median	Q1	Q3
C1. I can organize course material into a logical structure.	4	4	5
C2. I cannot produce a course study guide (compilation of personal notes, exercises, and learning activities) for future students.	3	2	3
C3. I cannot demonstrate to others the numerical knowledge and skills learned in this course.	3	2	4
C4. I can self-learn, critique the lessons, and apply the mathematical skills learned in this course.	4	4	5
A1. I have changed my attitude (positive attitude) about the course subject matter due to this course.	4	4	5
A2. I feel more self-reliant as a result of the content learned in this course.	4	4	5
A3. I am actively involved in the online learning, i.e., attending all classes/ learning activities, paying attention, asking questions, and answering questions posed by the instructor	4	4	5

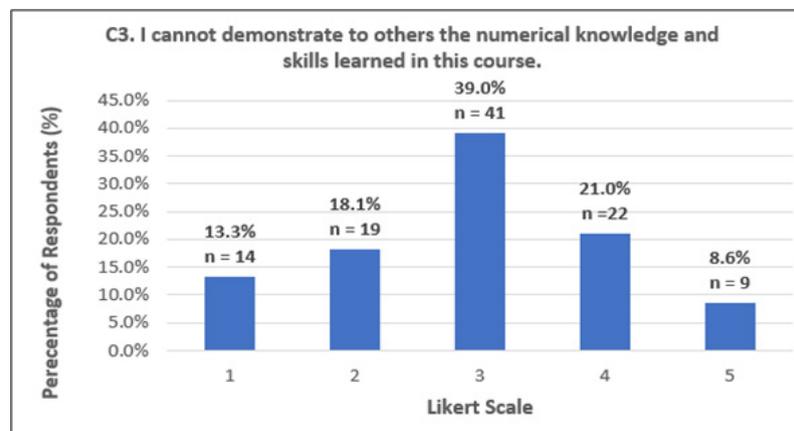


FIGURE 4. Percentage of respondents for item C3

Item C4 assessed the students' perception of their ability to self-learn, critique the lessons, and apply mathematical skills learned in this course. Figure 5 indicated that 79% of the students strongly agree/agree with the statement in C4. Only 1% disagree with the statement. The IQR = 1 in Table 3 for item C4 indicated strong consensus at level 4 of the Likert scale, where most students agreed with C4.

Figure 6 shows 84.8% (89 students) have a change of attitude (positive attitude) due to the course, whereas 13.3% were unsure, and 1.9% disagree that they have a changed attitude. Table 3 shows a strong consensus (IQR = 1) in agreement with item A1 at level 4 of the Likert scale. Students with changed attitudes, representing a large bulk of the population, may have a growing interest in an engineering course requiring strong mathematical fundamentals. In addition, this may also indicate that students were able to value the knowledge learned in this course and could see its foundational benefit for other courses they need to pursue in future semesters.

As shown in Figure 7, the graph highlights a robust correlation between the course content and feelings of self-reliance among students. Notably, a considerable percentage, 33.3%, unequivocally strongly agree with item A2, indicating the ability to self-learn. Furthermore, 46.7% of participants agreed, reinforcing this positive trend. This suggests a promising avenue for further investigation into the specific elements of the course content that contribute most significantly to fostering self-reliance among students. On the other hand, a neutral stance was adopted by 17.1% of respondents, whereas a mere 2.9% conveyed disagreement, with no instances of strong disagreement. Table 3 indicated a strong consensus of responses at level 4 of the Likert scale.

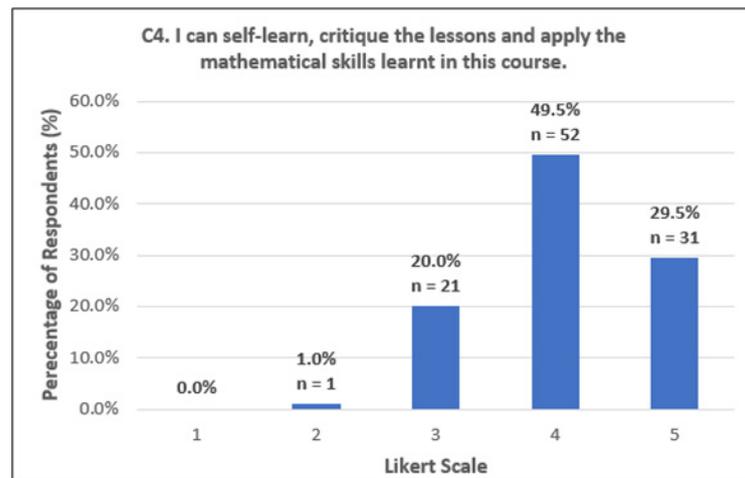


FIGURE 5. Percentage of respondents for item C4

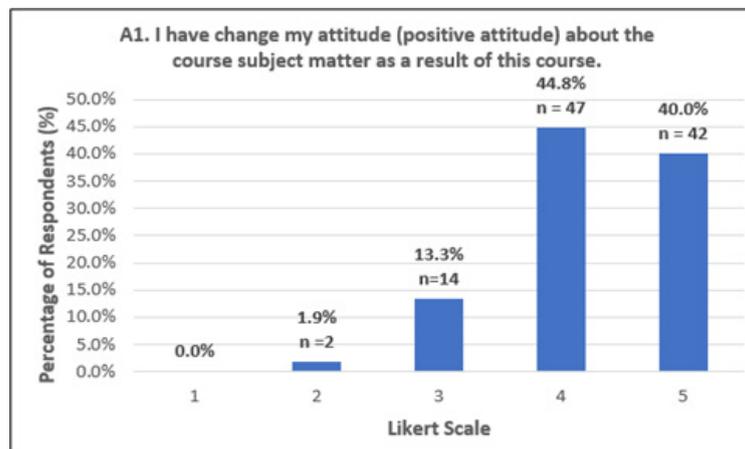


FIGURE 6. Percentage of respondents for item A1

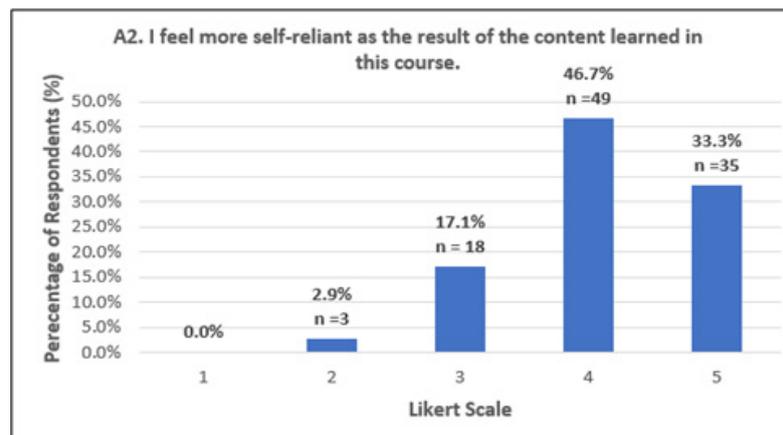


FIGURE 7. Percentage of respondents for item A2

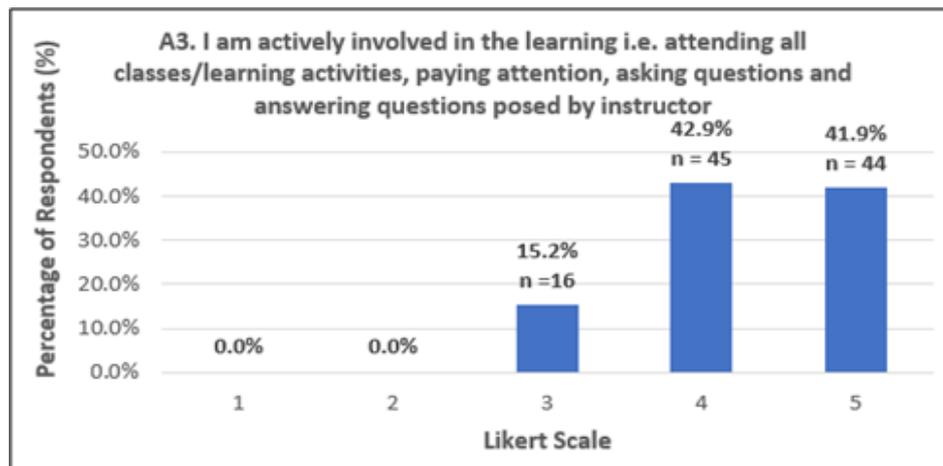


FIGURE 8. Percentage of respondents for item A3

The graph in Figure 8 depicts a high degree of student engagement in learning. A substantial portion, 41.9%, expressed strong agreement regarding active participation, indicative of a noteworthy segment of the class actively attending lectures, participating in activities, and engaging with the instructor. Furthermore, 42.9% of respondents expressed partial agreement, resulting in more than 80% of students agreeing with item A3. This highlights the effectiveness of instructional methods and course design in promoting student involvement and suggests potential areas for refinement or expansion to enhance engagement even further. Merely 15.2% reported neutrality in Figure 8 and no instances of disagreement, reflecting a favorable learning atmosphere conducive to engagement and participation. Similar to items A1 and A2, item A3 also showed strong consensus on the Likert scale of 4, indicating positive perception in affective learning.

CORRELATION OF ENTRY QUALIFICATIONS WITH PERCEIVED COGNITIVE LEARNING

A Kruskal-Wallis test was conducted to examine if there are statistically significant differences in students' perceptions of cognitive abilities across various entry qualifications. The test addressed the question, "Is there a significant difference in students' perceptions of cognitive abilities based on their entry qualifications?". For this question, the independent variable is the entry qualification, and the dependent variable is students' perception of their cognitive abilities, assessed through four different cognitive questions (C1, C2, C3, C4) rated using the Likert scale.

The mean rank values shown in TABLE 4 for each cognitive question across the different entry qualifications provide an insightful depiction of the students' self-

assessed cognitive abilities. For C1, which assesses the ability to organize course material logically, students with UiTM diplomas reported the highest mean rank (67.00), suggesting a strong self-perception in this cognitive domain, followed by those with Matriculation (60.67), Others (51.62), and Polytechnic diplomas (35.35). This trend, however, does not uniformly persist across other cognitive questions, as evidenced by C2 (producing a study guide), the mean ranks are closely grouped, with UiTM diploma students (59.50) leading, followed by Matriculation (54.12), Polytechnic diploma (53.67), and Others (49.58). The minor differences and a non-significant Kruskal-Wallis H ($p=0.911$) indicate that students' perceptions are relatively uniform across entry qualifications. This is further shown by C3 (demonstrating numerical knowledge and skills), where the mean ranks are nearly identical: Others (54.90), UiTM diploma (54.75), Matriculation (52.34), and Polytechnic diploma (52.24). This uniformity, coupled with a non-significant $p=0.984$, suggests no discernible differences among groups. C4 (self-learning and applying mathematical skills) displays more variation, with UiTM diploma students again highest (69.25) and Polytechnic diploma students lowest (43.02).

The Kruskal-Wallis H statistic in TABLE 4 further illuminates these observations. For C1, the test yielded a value of 13.861 with a significance level of .003, indicating a statistically significant difference in students' perceptions of their ability to organize course material across different entry qualifications. This suggests that the entry qualification influences students' perceptions of their organizational capabilities in academic contexts. Conversely, for C2 (ability to produce a study guide) and C3 (demonstrating numerical knowledge), the Kruskal-Wallis H values were .536 and .160 with p-values of .911 and .984, respectively.

These results signify no statistically significant difference in students' perceptions across different entry qualifications for these specific cognitive abilities. Such findings imply

a homogeneity in students' self-assessment of their abilities to produce study guides and demonstrate numerical knowledge, regardless of their entry qualification.

TABLE 4. Kruskal-Wallis test generated by SPSS on the effect of entry qualifications on perceived cognitive learning

		Ranks	
	EntryQual_Num	N	Mean Rank
C1	Matriculation	54	60.67
	Others	26	51.62
	Polytechnic diploma	23	35.35
	UiTM diploma	2	67.00
	Total	105	
C2	Matriculation	54	54.12
	Others	26	49.58
	Polytechnic diploma	23	53.67
	UiTM diploma	2	59.50
	Total	105	
C3	Matriculation	54	52.34
	Others	26	54.90
	Polytechnic diploma	23	52.24
	UiTM diploma	2	54.75
	Total	105	
C4	Matriculation	54	58.65
	Others	26	48.85
	Polytechnic diploma	23	43.02
	UiTM diploma	2	69.25
	Total	105	

	Test Statistics ^{a,b}			
	C1	C2	C3	C4
Kruskal-Wallis H	13.861	.536	.160	6.367
Df	3	3	3	3
Asymp. Sig.	.003	.911	.984	.095

a. Kruskal Wallis Test

b. Grouping Variable: EntryQual_Num

Item C4, which evaluates the self-perceived ability to self-learn and apply mathematical skills, presented a Kruskal-Wallis H value of 6.367 with a p-value of .095. Although this does not reach the conventional threshold for statistical significance ($p < .05$), it suggests a marginal difference in perceptions across entry qualifications. Notably, students with UiTM diplomas reported the highest mean rank (69.25), indicating a stronger self-perception in self-directed learning and application of mathematical skills compared to their peers.

In summary, the Kruskal-Wallis test revealed significant differences in how students perceive their ability to organize course material based on their entry qualifications. However, no significant differences were observed in the abilities to produce a study guide and demonstrate numerical knowledge. A marginal difference was noted in the self-assessment of self-learning and application of mathematical skills. These insights underscore the influence of educational background on certain aspects of students' self-perceived cognitive abilities, highlighting the importance of considering entry qualifications in educational research and practice.

CORRELATION OF ENTRY QUALIFICATIONS
WITH PERCEIVED AFFECTIVE LEARNING

The Kruskal-Wallis test was similarly applied to examine variations in students' affective responses to the course, defined by different entry qualifications. Affective responses encompass students' attitudes, confidence, and involvement in learning, which are pivotal for holistic educational outcomes. The independent variable for this analysis remains the Entry Qualification, with the dependent variable being the affective domain, assessed through three questions (A1, A2, A3) gauged by the Likert scale.

The mean rank summaries shown in TABLE 5 for each affective question across different entry qualifications

clearly show students' affective experiences. For item A1, students with UiTM diplomas and those with Matriculation exhibit higher mean ranks (62.25 and 62.31, respectively), indicating a more significant positive shift in attitudes toward the course subject matter than students from other entry qualifications. Similarly, UiTM diploma holders again show the highest mean rank (67.00) for item A2, suggesting that this group feels a notable increase in self-reliance from the course content; Matriculation students also reported high mean ranks (61.06). For active involvement in learning assessed by item A3, UiTM diploma students stand out with an exceptionally high mean rank (83.50), indicating a high level of engagement in learning activities, markedly higher than their peers from other entry qualifications.

TABLE 5. Kruskal-Wallis test generated by SPSS on the effect of entry qualifications on perceived affective learning

Ranks			
	EntryQual_Num	N	Mean Rank
A1	Matriculation	54	62.31
	Others	26	42.29
	Polytechnic diploma	23	42.43
	UiTM diploma	2	62.25
	Total	105	
A2	Matriculation	54	61.06
	Others	26	44.65
	Polytechnic diploma	23	42.28
	UiTM diploma	2	67.00
	Total	105	
A3	Matriculation	54	58.94
	Others	26	48.54
	Polytechnic diploma	23	41.43
	UiTM diploma	2	83.50
	Total	105	
Test Statistics ^{a,b}			
	A1	A2	A3
Kruskal-Wallis H	13.294	10.522	9.403
Df	3	3	3
Asymp. Sig.	.004	.015	.024

a. Kruskal Wallis Test

b. Grouping Variable: EntryQual_Num

The Kruskal-Wallis H test statistics in TABLE 5 reinforce these observations. The H values for A1 (13.294, $p = .004$), A2 (10.522, $p = .015$), and A3 (9.403, $p = .024$) all indicate statistically significant differences in affective responses across different entry qualifications. This underscores the role of entry qualifications in influencing students' attitudes, feelings of self-reliance, and engagement in the learning process.

In interpreting these results, it is important to consider factors such as the sample size and distribution, especially the small number of UiTM diploma holders, which could influence the mean ranks and significance levels. Additionally, although common, the reliance on Likert scales for measuring affective responses carries limitations in capturing the full spectrum of students' feelings and attitudes.

Each has a negative correlation coefficient with SPM mathematics grades: -0.131 for C1, -0.110 for C2, -0.059 for C3, and -0.109 for C4. The negative values indicate inverse relationships, albeit very weak ones, as none are statistically significant, with p-values exceeding the conventional threshold for significance (0.05). The trend shows negligible negative correlations with mathematics grades are discernible across the cognitive variables (C1 to C4). The capacities for organizing course material, compiling study guides, demonstrating numerical knowledge, and engaging in autonomous learning appear to have an inconsequential relationship with mathematics grades within this data set.

Pivoting to the affective domain, a similar pattern can be observed. Changes in attitude towards the course (A1), feelings of self-reliance (A2), and active involvement in learning (A3) yield correlation coefficients of -0.137, -0.115, and -0.061, respectively. Again, these negative values suggest weak inverse relationships with prior mathematics performance, and none are statistically significant, indicated by p-values that do not meet the threshold for significance. Changes in attitude towards the subject matter, increased self-reliance, or active engagement in the learning process do not correlate significantly with mathematics grades, suggesting that these affective responses have a limited bearing on mathematical success in this cohort.

This absence of significant correlations prompts a reflection on what other factors could be more pivotal in influencing math grades. It suggests that other unexamined variables might be more crucial in determining students' success in mathematics. It also underscores the complexity of academic achievement, hinting at a multifaceted web of influences beyond just cognitive and affective perceptions.

CORRELATIONS WITHIN AND BETWEEN LEARNING PERCEPTIONS

The data does show significant correlations within the cognitive variables themselves, indicating interrelated perceptions between them. The significant correlations between the cognitive and affective variables suggest that students' perceptions in these areas are interconnected. Referring to Table 6, There is a strong positive correlation ($\rho = .585$, $p < .001$) between students' confidence in organizing course material (C1) and their ability to self-learn and apply mathematical skills (C4). This suggests that students who can structure their learning materials also tend to feel more confident learning independently and applying what they have learned.

Table 6 also shows a very strong positive correlation ($\rho = .764$, $p < .001$) between the change in attitude towards the subject matter (A1) and feeling more self-reliant (A2). This implies that students who experience a positive shift in attitude also tend to feel more self-reliant because of the course. Another significant positive correlation ($\rho = .678$, $p < .001$) is observed between changes in attitude (A1) and active involvement in learning (A3). This could mean those who develop a more positive attitude are more likely to engage actively in their learning process. There is a strong positive correlation ($\rho = .718$, $p < .001$) between feeling more self-reliant (A2) and being actively involved in learning (A3). This suggests that students who feel more capable and self-reliant are more engaged in the learning activities.

Referring to TABLE 6, a strong positive correlation ($\rho = .686$, $p < .001$) suggests that students who are confident in their ability to self-learn and critique lessons (C4) also tend to have a positive change in attitude towards the course material (A1). It is observed that there is a significant positive correlation ($\rho = .651$, $p < .001$) between the ability to self-learn (C4) and feeling more self-reliant (A2). It indicates that students confident in their self-learning abilities also feel more self-reliant. A strong positive correlation ($\rho = .624$, $p < .001$) between the ability to self-learn (C4) and active involvement in learning (A3) suggests that students who are good at self-learning are also more actively involved in the classroom.

These correlations suggest that students' learning experiences are multifaceted and that cognitive and affective aspects of learning are deeply intertwined. For example, students who have developed strong organizational skills might find it easier to engage with the material on a deeper level, facilitating self-directed learning and application of knowledge (C1 and C4 correlation). A positive attitude towards the subject could enhance students' engagement and willingness to take initiative in their learning, thereby increasing their self-reliance and active participation in educational activities (A1, A2, and A3 correlations).

The ability to self-learn and critically engage with lessons may boost students' confidence, leading to a more positive attitude towards the subject matter and a belief in their self-reliance (C4 with A1 and A2 correlations). These findings have important implications for educational practice. Understanding these relationships can help educators develop strategies that improve cognitive skills like organizing and applying knowledge and foster positive attitudes and self-reliance among students. For instance, teaching methods that encourage active learning and critical thinking could be beneficial.

CONCLUSION

To this end, the perceived cognitive and affective attainment of students undertaking a mathematics course in engineering and the correlations with different entry qualifications and SPM mathematics grades have been studied using descriptive statistics, the Kruskal-Wallis test, and the Spearman rank coefficient. The descriptive statistics revealed that around 80% or more of students are confident in organizing knowledge (C1) and self-directed learning (C4). However, approximately 30% of students are confident in producing a course learning guide (C2) and demonstrating their knowledge and skills to others (C3). Above 80% of the students perceived a positive change in attitude (A1), felt more self-reliant (A2), and could actively engage in the learning process (A3). This indicated a strong perception of affective attainment in this course. However, a deeper evaluation from the Kruskal-Wallis test analyses suggests that entry qualifications significantly shape students' perceptions of their cognitive and affective abilities. While the impact on cognitive abilities appears to be more selective, affecting primarily organizational skills, the influence on affective responses is more pervasive, impacting attitudes, self-reliance, and engagement across the board. On the other hand, the Spearman rank coefficient did not reveal any significant correlation between students' SPM mathematics grade and their perception of their cognitive and affective abilities in learning mathematics in this course. These results highlight the importance of considering students' entry qualifications in educational research and practice, as these backgrounds may predispose students to different learning experiences and outcomes. Specifically, the data suggest that students with UiTM diplomas may enter with or develop through their educational experience stronger organizational skills, more positive attitudes towards learning, greater self-reliance, and higher engagement levels compared to their peers from other entry qualifications.

ACKNOWLEDGEMENT

The authors thank Universiti Teknologi MARA for their financial support under the publication grant allocation scheme.

DECLARATION OF COMPETING INTEREST

None.

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