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Attitude towards Learning Statistics and Factors Associated with it among University Students, Sarawak, Malaysia

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ABSTRACT

Statistics is a course required for most undergraduate university students. Statistical methods are often used in problem solving in various fields, including information, communication technology, medicine, etc. This study examined students' attitudes towards learning statistics and its relationships with perceived academic performance, learning styles, and educational environment. This cross-sectional study at UNIMAS involved 610 undergraduate students. It used multistage cluster sampling and a questionnaire to assess attitudes towards statistics, learning styles, academic performance, and academic environment. Data were analysed using hierarchical multiple regression. The study examined attitudes toward learning statistics among 610 university students, predominantly female (65.9%) and in their second year (90.7%). Students reported moderate overall academic performance (M=3.49, SD=0.43), with the highest scores in group work. The perceived academic environment was generally positive, with sports facilities and empathy learning rated highest. The learning style preferences showed a strong inclination towards visual (84.1%) and sensing (73.3%) styles, with 87% having a mild overall preference. Attitudes towards statistics were slightly positive (M=4.57, SD=0.61), with the highest scores in the effort and interest domain. Hierarchical regression analysis revealed that group work (β=.159, p<.001), work productivity (β=.197, p<0.001), and the perceived academic environment (β=.139, p<.001) were significant predictors of attitudes towards statistics in multiple domains. Age and gender had minimal impact on attitudes towards statistics, except for a slight female preference in the value domain (β=.086, p<.05). The effort domain was positively influenced by group work (β=.207, p<.001), work productivity (β=.222, p<.001), and the academic environment (β=.252, p<.001). In contrast, the affective domain was negatively influenced by cognitive ability (β=-.115, p<.01) and impulse control (β=-.169, p<.001). These findings provide insight into the factors that affect student attitudes toward statistics, highlighting the importance of collaborative learning, productivity, and a supportive academic environment.

Keywords: Learning statistics, academic performance, learning style, academic environment

INTRODUCTION

Statistics is a crucial field that involves collecting and analysing numerical data to make informed decisions (Chappelow, 2023). Its origins can be traced back to ancient times, when data was used to gain insight into agriculture, property, taxation, and government affairs (Williams et al., 2023). Nowadays, statistics are included in school curricula beginning with secondary education and are offered at various levels through certificates, associate degrees, bachelor's degrees, and master's degree programmes in different fields. The benefits of statistics include standardised data collection, financial management, data evaluation and comparison, and tracking trends and changes (Zach, 2021).

A comprehensive theoretical framework for studying attitudes towards learning statistics among Sarawakian university students should integrate multiple dimensions, including attitudes, motivation, learning environment, cognitive and non-cognitive factors, and cultural influences. This framework draws upon various established theories and recent research findings to provide a holistic understanding of the factors shaping students' engagement with statistics.

The foundation of this theoretical framework is built on the multidimensional nature of attitudes towards statistics, incorporating both cognitive and affective components. Research has consistently shown that students with stronger mathematical backgrounds tend to exhibit more positive attitudes toward statistics, highlighting the crucial role of prior knowledge in shaping perceptions and engagement (Zhang et al., 2012; Ismail et al., 2022). This aligns with the cognitive component of the tripartite model of attitudes proposed by Rosenberg and Hovland (1960), which encompasses affect, behaviour, and cognition. The attitude towards learning statistics among university students is influenced by a complex interplay of factors that can be understood through global and national contexts. Despite its importance, many undergraduate students perceive statistics negatively, which can significantly affect their academic performance (Lalayants, 2012; Hood & Neumann, 2013; Najmi et al., 2018). Factors influencing attitudes toward statistics include its perceived complexity, lack of relevance to future careers, and difficulty understanding its concepts (Ashaari et al., 2011; Silva et al., 2021). Students with weak mathematical backgrounds often struggle with statistics (Rylands & Coady, 2009), while those with better mathematical or statistical education experience are more likely to develop positive attitudes (Gal & Ginsburg, 1994; Zhang et al., 2012; Ismail et al., 2022). Furthermore, the attitudes of teachers can significantly impact students' interest in the subject, highlighting the importance of positive role models in statistics education (Gal & Ginsburg, 1994; Estrada et al., 2011; Bateiha et al., 2020).

Motivation plays a crucial role in this framework, drawing from intrinsic and extrinsic factors. The Technology Acceptance Model (Davis, 1989; Smith) can be adapted to understand how students perceive the usefulness and ease of use of statistics in their academic and professional lives (Jović et al., 2017; Mahlan et al., 2023). This model is in alignment with the findings of Froiland & Worrell (2016), who demonstrated a positive correlation between intrinsic motivation and student engagement and achievement. Additionally, Aslam (2021) emphasises the role of constructive feedback in enhancing motivation and academic performance. Moreover, Fa et al. (2021) found that students' attitudes towards formal statistics courses are linked to their overall learning outcomes, suggesting that motivation plays a pivotal role in their academic performance. Effective learning strategies are associated with higher motivation levels (Togia et al., 2012), and statistics show a significant relationship between motivation and academic performance (Widyastuti et al., 2019). In the Malaysian context, factors such as self-efficacy and the learning environment influence students' motivation (Hussein et al., 2021), with a supportive learning environment being essential to foster positive attitudes toward learning (Hasan et al., 2023).

The learning environment, which encompasses instructional quality and educator support, is another vital component of the framework. Mirawati and Sikarni (2023) and Mansor et al. (2018) highlight the importance of engaging in learning activities and the perceived value of statistics in shaping students' attitudes. This aspect of the framework aligns with Bandura's social cognitive theory (1986), which emphasises the interaction between personal factors, behaviour, and the environment in learning (1994).

Cognitive and non-cognitive factors are integrated into the framework, recognising their interplay in learning. Ismail et al. (2022) demonstrated that students' perceived ability in statistics significantly influences their understanding of basic statistical concepts, suggesting a strong link between self-efficacy (a non-cognitive factor) and cognitive competence. This integration is supported by the work of Togia et al. (2012) and Widyastuti et al. (2019), who established connections between learning strategies, motivation, and academic performance.

Finally, the framework incorporates cultural and contextual influences specific to Sarawak, Malaysia. Rahman et al. (2021) indicate that students' backgrounds, including socio-economic status, can influence their attitudes towards learning. This cultural dimension is crucial to accurately reflecting the unique experiences of university students (Choy et al., 2015) and aligns with the broader sociocultural theory of learning proposed by Vygotsky (1978).

This theoretical framework provides a comprehensive approach to understanding attitudes towards learning statistics among Sarawakian university students. Integrating multiple dimensions and drawing from established theories and recent research offers a robust foundation for investigating the complex interplay of factors that influence students' engagement with and performance in statistics. This model can guide educators in the development of targeted interventions and customised learning materials to foster positive attitudes and improve learning outcomes in statistics education.

Therefore, the study of attitudes towards learning statistics among university students in Sarawak, Malaysia, is important due to several key factors. Understanding the local context is crucial, as it provides insights into the specific attitudes and challenges faced by students in Sarawak, considering the unique cultural and educational environment of the region (Muftah & Rafik-Galea, 2013). This localised understanding aids in

developing targeted interventions and teaching strategies that can improve educational outcomes by identifying factors influencing students' attitudes towards statistics (Christou & Dinov, 2010; Ghulami et al., 2015). Many students perceive statistics as a difficult subject, which can hinder their learning; therefore, this study helps identify the sources of these negative attitudes and offers ways to address them, potentially increasing student engagement and success (Lalayants, 2012; Hood & Neumann, 2013; Najmi et al., 2018). Enhancing statistical literacy is also a critical outcome, as it is essential across various disciplines in an era of big data, contributing to a more statistically literate workforce in Sarawak and Malaysia (Zhang et al., 2012; Ismail et al., 2022). Furthermore, the findings can inform educational policies and practices at the university level, leading to curriculum reforms and improved teaching approaches in statistics education (Gal & Ginsburg, 1994; Estrada et al., 2011; Bateiha et al., 2020). By focusing on Sarawak, the study would also show how cultural factors specific to the region can influence attitudes toward statistics, providing valuable data for cross-cultural educational research (Rahman et al., 2021). This study is significant as it addresses a crucial aspect of education in an increasingly data-driven world, with potential implications for educational practice, policy and research in Sarawak and beyond. Taking into account the contexts, this study aims to generate evidence and understand undergraduate students' learning styles and attitudes toward statistics. The study also aims to determine whether the learning environment can enhance the learning attitude toward statistics and how the learning styles modify the attitude toward statistics. The findings of the study can help educators teach statistics more effectively and provide a conducive learning environment to improve student academic performance.

MATERIALS AND METHODS

Setting, Place, and Population

This research was a cross-sectional study with a quantitative approach to determine student attitudes towards statistics and its relationships with learning styles, academic environment, and academic performance among university students. The study was carried out at the University of Malaysia Sarawak (UNIMAS), located in Kota Samarahan, Sarawak, Malaysia, with ten faculties. All other undergraduate students at UNIMAS, regardless of gender and nationality, were included in the study population, provided they could communicate in English and gave their informed consent. Students who were unwilling to participate in the study were excluded. This study collected data from 610 students with a response rate of 98.4%.

Sample Size and Sampling

To determine the sample size for the study, the researchers assumed that the dependent variable, attitude towards statistics, was continuous and expected to conduct correlation analysis. With an assumed effect size of 0.25, an absolute margin of error of 0.05, and a power of 0.80 (Bujang & Baharum, 2016), the initial sample size was calculated to be 269. This was further increased to 538 after multiplication using a design effect 2.0 and adjusted for non-response to 620 using the G*Power software version 3.1 (Faul et al., 2007). The sampling procedure involved a multistage cluster sampling technique. In the first stage, all faculties that offer statistics courses were purportedly selected. In the second stage, at least one discipline was randomly selected from each faculty. In the third stage, the year of the students was randomly selected, and in the final stage, all students in the selected classrooms were chosen with a 100% selection probability. In general, the study aimed to include undergraduate students from year 1 to year 2, depending on their course and faculty, who gave their informed consent and were able to communicate in English.

Data Collection Instruments and Data Collection Procedure

The data collection instruments for this study included a questionnaire with five components. The first part was about students' attitudes towards statistics and used a 7-point Likert scale. Responses range from 1 (strongly disagree) to 4 (neither disagree nor agree) to 7 (strongly agree). The original questions had 36 items with positive and negative responses. There were six domains: effort, affective, cognitive, value, difficulty, and interest. Two items in the affective domain and three items in the difficulty domain were removed to improve reliability analysis. Domain-wise, the Cronbach alpha ranges from 0.651 to 0.809. The overall Cronbach alpha was 0.852, with excellent internal consistency.

The second part was the index of learning styles, which consists of 44 questions adapted from Felder and Brent (2016). Students were required to choose one answer option for each question. If both choices seemed to apply to students, they were required to choose the one that applied the most frequently. The complete set of questions had four domains: active vs. reflective, sensing vs. intuitive, visual vs. verbal, and sequential vs. global.

Each domain consists of 11 items. Students were required to choose one answer option for each question. If both choices seem to apply to students, they must choose the one that applies most frequently.

The third part evaluated the student's academic performance by asking questions about different activities relevant to his education. A total of 13 questions were asked on a Likert scale. The answer options ranged from never, rarely, sometimes, often, and very often. Each question required a response based on the estimate of the student's academic performance in the last week (Quadri et al., 2017). Initially, 17 questions were included in the assessment of perceived academic performance. Four-item questions were removed after psychometric analysis by exploratory factor analysis (Yong & Pearce, 2013). Then, it was classified into five domains: group work, cognitive ability, impulse control, quality of work, and productivity. Cronbach's alpha of domains varies from 0.578 to 0.821.

In the fourth part, 18 statements were used to assess the congenial academic environment perceived as conducive to learning. The statements were rated on the Likert scale from 1 (strongly disagree) to 7 (strongly agree). The students were required to choose an option for each statement. The rating scale was adopted and modified from different sources (Shochet et al., 2015). The average score for the perceived academic environment (SD) was 5.06 (0.85), ranging from 2.06 to 7.0. Cronbach's alpha was 0.934, indicating excellent internal consistency. Finally, the last part of the questionnaire was about the sociodemographic characteristics of the students and included six questions.

The data collection procedure involved distributing the self-administered questionnaire to undergraduate students in each course. The students received a brief explanation of the research objectives and sufficient time to respond to the questionnaire. The researchers were available to clarify questions or avoid missing information and questionnaires were collected immediately after completion. The participation of the students in this research was voluntary, and the study objectives were clearly explained to them. All responses were kept confidential and the identities and personal information of the students were kept secret. Ethics clearance was obtained from the Faculty of Medicine and Health Sciences and personal information of the students was not disclosed.

Data Analysis

The collected data were manually checked for inconsistencies and validated by checking for duplication, missing values, and outliers. Exploratory data analysis was performed to determine potential outliers and skewed data. A hierarchical multiple regression analysis was performed to determine the factors associated with the perceived attitudes of the students towards statistics. Univariate and multivariate outliers were determined using the Mahalanobis distance (Sharma, 2018). A total of 93 data were removed due to outliers. The results were presented in tables and graphs in the final report, and a p-value less than 0.05 was considered statistically significant. IBM SPSS version 27.0 was used for data analysis (IBM Corp, 2021). The study lasted 11 months, from September 2018 to August 2019.

RESULTS

Characteristics of the Students

Table 1 presents the characteristics of the student sample (N = 610). The mean age of the participants was 21.34 years (SD = 0.87), ranging from 19 to 26 years. The majority of the students (56.4%, n = 344) were 21 years old, while 33.9% (n = 207) were 22 years or older, and 9.7% (n = 59) were between 19 and 20 years old. The sample was predominantly female (65.9%, n = 402), with males comprising 34.1% (n = 208) of the participants. Regarding the year of study, a large majority of students (90.7%, n = 553) were in their second year, while 9.3% (n = 57) were in their first year.

Table 1. Characteristics of the students

Characteristics	Frequency	%	Statistics
Age in years			Mean (SD) = 21.34
19-20	59	9.7	(0.87) years,
21	344	56.4	Min = 19 years
≥22	207	33.9	Max=26 yrs
Gender			
Male	208	34.1	
Female	402	65.9	
Year of study			
Year 1	57	9.3	
Year 2	553	90.7	

Perceived Academic Performance

The students' self-reported perceived academic performance across five domains was measured using a 13-item Likert scale ranging from "never" to "very often." The overall mean score for perceived academic performance was 3.49 (SD = 0.43), indicating that, on average, students reported engaging in academically relevant activities between "sometimes" and "often." The students reported the highest performance in group work (M = 3.86, SD = 0.73), suggesting that they frequently participated in collaborative academic activities. Quality of work (M = 3.50, SD = 0.65) and productivity (M = 3.48, SD = 0.80) were rated similarly, with mean scores indicating that students perceived their performance in these areas as slightly above average. Cognitive ability (M = 3.30, SD = 0.79) and impulse control (M = 3.29, SD = 0.71) received the lowest scores among the five domains. However, these scores still suggest that students perceived their performance in these areas as occurring more than "sometimes" but less than "often." The relatively small standard deviations (ranging from 0.65 to 0.80) indicate moderate response variability across all domains. The standard deviation of 0.43 suggests less variability in the composite score of perceived academic performance compared to individual domain scores (Table 2).

Table 2. Perceived academic performance

Domains	No. of Items	Mean	SD
Group work	2	3.86	0.73
Cognitive ability	2	3.30	0.79
Impulse control	3	3.29	0.71
Quality of work	3	3.50	0.65
Productivity	3	3.48	0.80
Overall	13	3.49	0.43

Perceived academic environment

Table 3 shows the percentage distribution by item of the perceived academic environment. The highest mean score was 5.43 (1.2) for the statement *'Sport / recreation facilities are available at the university*' followed by '*I have learnt a lot about empathy in my profession*' with a mean score 5.28(1.2). However, the lowest score was 4.67 (1.6) for the statement '*fresh and healthy food is available at the university' and 'The recommended textbooks / e-books are always available*' with score 4.71(1.3).

Table 3. Perceived academic environment

Statements	Mean	SD
Sport / recreation facilities are available at the university.	5.43	1.2
I have learnt a lot about empathy in my profession.	5.28	1.2
The teachers have good communication skills with us.	5.26	1.2
My problem solving skills are being developed here well.	5.23	1.2
My social life is good.	5.22	1.2
I feel comfortable in class socially.	5.20	1.2
Teaching helps develop my confidence.	5.17	1.2
Classrooms are continuously supported with ICT facilities.	5.16	1.3
There are opportunities for me to develop interpersonal skills.	5.11	1.2
I feel able to ask the questions I want.	5.03	1.3
The atmosphere is relaxed during seminars/tutorials.	5.02	1.2
The instructional materials are always available.	5.00	1.2
The teachers provide constructive criticism here.	4.96	1.2
The well-furnished classroom at the university.	4.91	1.4
I feel well prepared for my profession.	4.79	1.2
The recommended textbooks/e-books are always available.	4.71	1.3
Fresh and healthy food is available at the university.	4.67	1.6

Perception Of Learning Style

Table 4 presents the distribution of perceived learning styles among the student sample (N = 610) in four dimensions. In the active-reflective dimension, a slight majority of students (56.4%, n = 344) identified themselves as active learners, while 43.6% (n = 266) perceived themselves as reflective learners. This suggests a relatively balanced distribution between these two learning approaches, with a slight preference for active learning. The sensing-intuitive dimension showed a more pronounced preference, with nearly three-quarters of the students (73.3%, n = 445) identifying themselves as sensing learners. On the contrary, only 27.0% (n = 165) perceived themselves as intuitive learners. This indicates a strong tendency towards a sensing learning style in the sample. The visual-verbal dimension displayed the most skewed distribution. A substantial majority of students (84.1%, n = 513) identified themselves as visual learners, while only 15.9% (n = 97) perceived themselves as verbal learners. This suggests a strong preference for visual learning methods among participants. Lastly, in the sequential-global dimension, 62.3% (n = 380) of the students identified themselves as sequential learners, compared to 37.7% (n = 230) who perceived themselves as global learners. This indicates a moderate preference for sequential learning approaches in the sample.

Table 4. Perceived learning style

Learning style	Frequency	%
Active vs reflective		
Active	344	56.4
Reflective	266	43.6
Sensing vs intuitive		
Sensing	445	73.3
Intuitive	165	27.0
Visual vs verbal		
Visual	513	84.1
Verbal	97	15.9
Sequential vs global		
Sequential	380	62.3
Global	230	37.7

Dimension of learning: Based on the preference of each item of the question or the response choice, a weighted score was calculated, ranging from 0 to 11. If the score on a scale is 1-3, the student has a mild preference for one or the other dimension. If the score on a scale is 5-7, the student has a moderate preference for one dimension of the scale. If the score on a scale is 9-11, the student has a strong preference for one dimension of the scale. Analysis revealed that 87% had a mild preference for one dimension of learning, i.e. balanced learners, 11.1% had a

moderate preference for one dimension, and 1.8% had a strong preference for one dimension of learning (Figure 1). It is considered a well-balanced learning style.

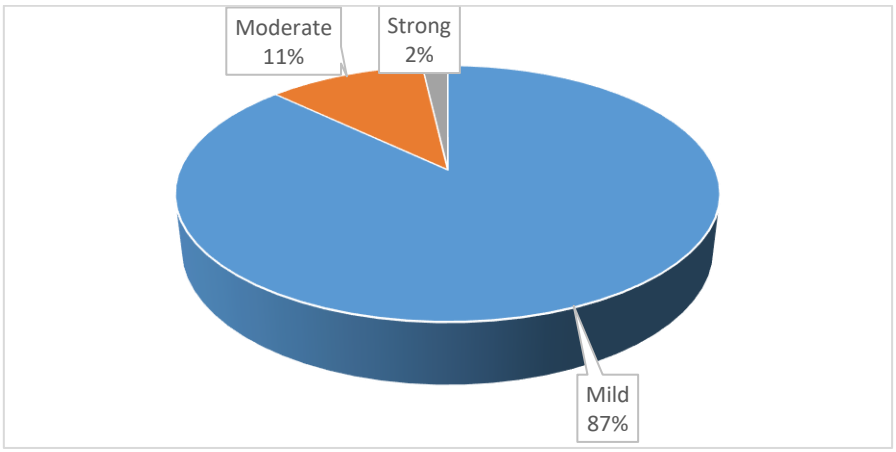

Figure 1. Dimension of the learning style

Perception Of Student Attitude Towards Learning Statistics

Table 5 presents students' perceived attitudes towards learning statistics, measured across six domains using a 31-item, 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The overall mean score for attitudes towards statistics was 4.57 (SD = 0.61), indicating a slightly positive attitude toward agreement. Students reported the highest scores in the effort domain (M = 5.59, SD = 1.02), suggesting that they strongly agree with the effort put into learning statistics. The interest domain also received a relatively high score (M = 4.70, SD = 1.09), indicating that students tend to find statistics somewhat interesting. The difficulty domain (M = 4.53, SD = 0.73) and the cognitive domain (M = 4.47, SD = 0.80) received scores above the midpoint, suggesting that students perceive statistics as moderately challenging and engage in cognitive processes when learning the subject.

The value domain (M = 4.35, SD = 0.84) indicates that students generally recognise the importance of statistics, although to a moderate degree. The affective domain received the lowest score (M = 3.74, SD = 1.13), suggesting that the students have somewhat neutral emotional responses to the statistics, leaning slightly toward positive feelings. Standard deviations between domains (ranging from 0.73 to 1.13) indicate moderate variability in responses, with the affective domain showing the highest variability. The overall standard deviation of 0.61 suggests less variability in the composite attitude score compared to individual domain scores. These findings provide insights into students' multifaceted attitudes towards learning statistics, highlighting areas where students feel more positive (effort and interest) and areas that may require additional support (affective responses).

Table 5. Perceived attitude towards learning statistics

Domains	No. of item	Mean	SD
Efforts	4	5.59	1.02
Affective	4	3.74	1.13
Cognitive	8	4.47	0.80
Value	7	4.35	0.84
Difficulty	4	4.53	0.73
Interest	4	4.70	1.09
Overall	31	4.57	0.61

Factors That Affect the Student's Attitude Toward Learning Statistics: Hierarchical Multiple Linear Regression Analysis

Initially, there were two variables, viz. Age in years and gender were entered into the model, followed by other variables such as domains of perceived academic performance (group work, cognitive ability, impulse control, quality of work, and productivity), perceived academic environment, and perceived learning style were entered into the model for each domain. In the first model, age and gender had no potential impact except in the 'value' domain; however, when the other variables were entered into the second model, this was indicated by a significant improvement in the adjusted R square and the statistically significant F ratio ($p<.001$).

The analysis revealed that the domain of 'effort' was significantly positively influenced by the academic performance of group work (β=.207), the productivity of work (β=.222) and the academic environment (β=.252) ($p<.001$). However, the 'affective' domain is significantly negatively influenced by cognitive ability (β=-.115) and impulse control (β=-.169). The 'cognitive' level of the student's attitude toward statistics was significantly influenced by group work (β=.113), impulse control (β=-.126) and the productivity of the work (β=.147). The 'value' domain was significantly influenced by gender, with a female preponderance (β=.086), group work (β=.119), and impulse control (β=-.143). The attitude domain of 'difficulty' was significantly influenced by group work (β=.140), impulse control (β=.141) and productivity of work (β=.094). The perceived academic environment also significantly influenced the 'difficulty' domain of attitude (β=.191). 'Interest' in statistics was significantly influenced by the productivity of work (β =.198) and the work (β=.198) and perceived academic environment (β=.223).

The general attitude of the student towards statistics was significantly influenced by group work (β=.159), the productivity of work (β=.197) and the perceived academic environment (β=.193). Across all models, the analysis found that group work, productivity of work, and perceived academic environment appeared to be potential predictors of student attitudes towards learning statistics. However, age, sex, cognitive ability, quality of work, and perceived difficulty of learning statistics had little or no potential impact on students' attitudes towards learning statistics ($p>.05$).

Table 6. Factors affecting student's attitude towards learning statistics: Hierarchical multiple linear regression analysis

Model		Domain-wise standardised beta coefficient learning statistics						
		Effort	**Affective**	**Cognitive**	**Value**	**Difficult**	**Interest**	**SAT**
1	(Constant)	.000	0.004	0.001	0.001	0.001	0.001	0.001
	Age in years	-.087*	.018	-.066	-.065	.005	-.002	-.057
	Gender	.031	.068	.074	.109*	-.036	-.041	.066
	Adj R^2	0.005	0.001	0.006	0.013	0.003	0.002	0.004
	F ratio (2,514)	2.225	1.263	2.590	4.267**	0.344	0.428	1.978
2	(Constant, p)	0.001	0.001	0.001	0.001	.183	0.382	0.001
	Age in years	-.063	.017	-.051	-.048	.023	.017	-.033
	Gender	.033	.048	.058	.086*	-.028	-.025	.054
	Group work	.207***	.024	.113**	.119*	.140**	.024	.159***
	Cognitive ability	-.035	-.115**	-.060	-.010	.072	.083	-.027
	Impulse control	.058	-.169***	-.126***	-.143**	.141**	.063	-.074
	Quality of work	-.040	.011	.035	-.002	.062	.057	.030
	Productivity	.222***	.047	.147***	.078	.094*	.198***	.197***
	Academic environment	.252***	-.097	.049	.014	.191***	.223***	.139***
	Dimension of learning	-.030	-.003	-.011	-.018	-.047	-.031	-.033
	Adj R^2	0.217***	0.048***	0.066***	0.043**	0.158***	0.161***	0.130***
	F ratio (9,507)	16.865***	3.913***	5.069***	3.573***	11.755***	11.975***	9.600***
	N	517	517	517	517	517	517	517

**p<0.05; **p<0.01; ***p<0.001*
SAT= attitude towards statistics

DISCUSSION

The statistics course helps students develop critical and analytical thinking skills (Callingham & Watson, 2017; Kim & Kim, 2019). However, most students' first exposure to statistics courses occurs only in high school and introductory undergraduate coursework at the university level(Sadler & Sonnert, 2018). Many courses at the undergraduate level may require research. In these instances, the students must know measurements and statistics. Thus, knowledge and skill in statistics guide students in reading and interpreting scientific writing such as journals, dissertations, reports, etc. Considering this, the current study aims to determine the student's attitude towards learning statistics.

The present study examined factors influencing students' attitudes towards learning statistics across multiple domains: effort, affective responses, cognitive attitudes, perceived value, difficulty, interest, and overall attitude. The findings reveal a complex interplay of demographic, cognitive, and environmental variables that shape the participation of students in statistics education.

Our analysis revealed that age negatively predicted effort, suggesting that older students may experience a decrease in motivation or engagement levels in learning statistics. This aligns with previous research that indicates that older students may face competing life priorities that affect their academic engagement (Yang et al., 2011). In particular, group work, productivity, and the academic environment emerged as significant positive predictors of effort. These findings underscore the importance of collaborative learning experiences and a supportive academic environment in enhancing students' efforts to learn statistics, consistent with literature that emphasises the role of community in fostering student engagement (Yang et al., 2011; Akdemir, 2019; Lakhal et al., 2021).

Interestingly, cognitive ability and impulse control were found to be negative predictors of affective attitudes towards learning statistics. This counterintuitive finding suggests that students with higher cognitive ability and better impulse control may have less favourable emotional responses to learning statistics. This phenomenon could reflect a critical or cynical attitude toward the learning process among high-performing students, potentially leading to emotional disengagement (Mohammed Zabidi et al., 2023). These results challenge the traditional notion that higher cognitive abilities and self-regulation skills invariably lead to positive academic attitudes, highlighting the complex relationship between cognitive factors and emotional engagement in learning statistics.

Group work and productivity emerged as positive predictors of cognitive attitudes, while impulse control was a negative predictor. These findings align with research that emphasises the effectiveness of cooperative learning strategies in fostering cognitive engagement (Febrina, 2023). The positive impact of productivity on cognitive attitudes corroborates the idea that students' perceptions of their effectiveness can enhance their cognitive engagement with the subject matter (Quirós et al., 2023). The negative relationship between impulse control and cognitive attitudes suggests that students struggling with self-regulation may find it challenging to maintain focus and engagement in statistics courses (Kristiani et al., 2015).

Gender, group work, and impulse control were significant predictors of value attitudes toward statistics. The gender effect aligns with previous research exploring gender differences in educational contexts, although the nature of these differences remains complex and context-dependent (Hannigan et al., 2014; Stanisavljević et al., 2014). The positive impact of group work on value attitudes reinforces the importance of collaborative learning in enhancing students' perceptions of the relevance and importance of statistics.

Group work, impulse control, productivity, and the academic environment were positive predictors of perceived difficulty in learning statistics. These findings suggest that collaborative learning environments, self-regulation skills, productivity feelings, and a supportive academic context can help students navigate the challenges of learning statistics more effectively (Liu et al., 2016; Bagazi, 2022; Morton et al., 2022; Fliah Hassan et al., 2023).

Productivity and the academic environment emerged as significant positive predictors of interest in statistics. This aligns with the Expectancy-Value Theory, which posits that students' motivation and interest are influenced by their expectations of success and the value they place on the subject matter (Ramirez et al., 2012). The importance of a supportive academic environment in fostering interest echoes previous findings on the role of contextual factors in enhancing motivation and engagement (Drent et al., 2019).

Group work, productivity, and academic environment were significant positive predictors of overall attitude towards statistics. These findings highlight the multifaceted nature of attitude formation, emphasising the

importance of collaborative learning, perceived effectiveness, and a supportive learning context in shaping students' general perceptions of statistics (Gorvine & Smith, 2014; Smith, 2017).

CONCLUSION

In conclusion, this comprehensive analysis of factors affecting students' attitudes towards learning statistics reveals a complex interplay of demographic, cognitive, and environmental variables across multiple domains. The findings consistently highlight the importance of collaborative learning (group work), individual productivity, and a supportive academic environment to foster positive attitudes toward statistics. These factors emerged as significant positive predictors in several domains: effort, cognitive attitudes, perceived difficulty, interest, and overall attitude. The study also underscores the nuanced roles of impulse control and cognitive ability, which showed varying effects across different attitudinal domains. Notably, the affective domain displayed unique patterns, suggesting that distinct factors may influence emotional responses to statistics. These results contribute to a more nuanced understanding of how students engage with and perceive statistics education, providing valuable information to educators and researchers. Future research should continue to explore these dynamics in diverse educational settings and among different student populations, potentially integrating interdisciplinary approaches to develop more effective strategies for enhancing students' attitudes, engagement, and ultimately, their competence in statistics.

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CONFLICT OF INTEREST

The authors of this work declare that they have no conflict of interest to disclose.

AUTHORS CONTRIBUTION

The manuscript was a collaborative effort, with Md Mizanur Rahman, Nik Noor Arba'iyah, Kam Su Ling, Nur Hanisah, and Mohd Faiz all contributing in various capacities. Each author played a crucial role in the drafting process, with MMR leading the responsibility for concept design and data analysis. Additionally, MMR was responsible for editing the manuscript. The other authors contributed to data collection and writing. All authors thoroughly reviewed the article and gave their approval for publication.

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