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Mapping Indonesian University Students' Attitudes Toward Statistics Using the Indonesian SATS-36

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Abstract

As statistics becomes increasingly important in higher education, understanding students' attitudes toward statistics is essential for improving statistics instruction and learning engagement. This cross-sectional descriptive-correlational study presents a descriptive attitudinal profiling of Indonesian university students' attitudes toward statistics using the validated Indonesian version of the Survey of Attitudes Toward Statistics-36. Data were collected from 310 students across several Indonesian universities, representing mathematics education, statistics, and other academic programs. Guided by five attitude dimensions (Affect, Cognitive Competence, Value, Difficulty, and Interest/Effort), the findings reveal a distinctive attitudinal pattern. Students reported low affect toward statistics while showing relatively high interest and effort, suggesting a possible affective-motivational divergence. They also recognized the value of statistics while maintaining negative emotional responses, reflecting a cognitive-affective gap. Perceptions of difficulty were generally moderate across academic programs, while motivation and perceived value tended to decline across semester stages. Among the five dimensions, perceived value emerged as an important leverage point for strengthening students' engagement with statistics, as indicated by its positive association with interest/effort ($r = 0.425$). These findings suggest that Indonesian students' attitudinal patterns toward statistics may not be fully captured by conventional affective-behavioral assumptions. Statistics instruction should strengthen the perceived relevance of statistics while directly addressing students' emotional resistance and learning difficulties.

Keywords: Attitudes toward statistics; SATS-36; University students; Attitudinal profiles; Statistics education; Indonesian higher education

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INTRODUCTION

Statistics has become an indispensable component of higher education curricula across disciplines, from social sciences and education to health sciences and engineering. Despite its growing curricular importance, decades of research have shown that many students continue to hold unfavorable attitudes toward statistics (Zimprich, 2012). These attitudes are often reflected in statistics-related anxiety (Zeidner, 1991), low confidence in learning and applying statistical concepts, and avoidance of statistics-intensive tasks or courses (Onwuegbuzie, 2003). These types of attitudes are especially important as they influence students' learning experiences and outcomes in statistics, sitting alongside achievement in own-entry statistics courses (Fitzgerald & Jurs, 1996), persistence and engagement with statistical learning (Cashin & Elmore, 2005) and a wider research literacy orientation to academic and appropriate workplace pathways post-program (Schau et al., 1995).

The most common instrument to measure such attitudes is (Survey of Attitudes Toward Statistics, SATS) (Schau et al., 1995). Initially (a four-factor model SATS-28: affect, cognitive

competence, value and difficulty) when the instrument originally developed, however later interest and effort being added to capture the motivational dimensions led the researcher(s), to rename it as SATS-36. SATS-36 position validated in Italian (Chiesi & Primi, 2009), Switzerland (Zimprich, 2012), Spanish (Rodriguez-Santero & Gil-Flores, 2019), Turkish (Sarikaya et al., 2018), Arabic (Alasim & Almohayya, 2023), Swedish (Persson et al., 2019), and Chinese (Li et al., 2024) contexts. Notwithstanding this global attention, five key gaps drive the present study.

First, almost all SATS studies with high citation counts are situated in a Western or East Asian context; they cannot be assumed to generalize to regions where both institutional structures and culturally-oriented attitudes toward mathematics differ greatly from those found in Southeast Asia. Second, previous studies are restricted to cohort studies in only one discipline (e.g., psychology) (Zimprich, 2012), education (Chiesi & Primi, 2009), (Rodriguez-Santero & Gil-Flores, 2019), or medicine students (Li et al., 2024), limiting comparison across disciplines even within a system. Third, existing studies rarely produce descriptive attitudinal profiles that integrate findings across multiple SATS-36 dimensions into pedagogically actionable interpretations. Fourth, implications of structural changes in new cultural contexts are under-theorized. Fifth, to our knowledge, no multi-disciplinary descriptive attitudinal profiling using the Indonesian SATS-36 exists for Indonesian students, despite Indonesia being the world's fourth most populous nation with a rapidly expanding higher education system. Table 1 compares five representative SATS studies selected based on citation count (>50 citations), use of SATS-28 or SATS-36, and peer-reviewed publication, with the present research, to delineate how this study extends prior work.

Table 1. Comparison of the present study with five highly-cited SATS studies

Study	Sample	Instrument	Design	Factors	Key Finding
Zimprich (2012)	346 Swiss psychology	SATS-28	CFA and regression	4	Affect (β = 0.43) and cogitive competence (β = 0.37): 30% achievement variance.
Chiesi and Primi (2009)	584 Italian undergrads	SATS-36	CFA cross-time	6	Affect most temporally sensitive and improved post-instruction.
Nolan et al. (2012)	56-study systematic review	SATS-28/36	Meta-review	4/6	SATS-36 best validity and value most debated cross-culturally.
Schau et al. (1995)	Instrument dev. sample	SATS-28	EFA and CFA	4	Original 4-factor validated and precursor of SATS-36.
Cashin and Elmore (2005)	1,162 US students	SATS-28	CFA and regression	4	SATS predicted achievement beyond demographics and value weakest.
Current study	310 Indonesian, multi-discipline	SATS-36 (Indonesian)	Descriptive-correlational	5	A multi-disciplinary Indonesian attitudinal profiling; possible affective-motivational divergence; value as key leverage.

Note. CFA = Confirmatory factor analysis; EFA = Exploratory factor analysis; β = Standardized regression coefficient; M = Mean.

As shown in Table 1, this study uniquely uses a validated Indonesian SATS-36 (Naqiyah et al., 2024), samples across multiple disciplines within one national system, applies descriptive attitudinal profiling across factor-level results, and identifies a possible affective-motivational

divergence not prominently documented in prior SATS-36 research. This divergence, high effort despite persistently negative feelings, may be consistent with collectivist academic culture and high-stakes curriculum requirements of Indonesian higher education (Ryan & Deci, 2000). Therefore, this study aims to present a descriptive attitudinal profiling of Indonesian university students' attitudes toward statistics using the validated Indonesian version of SATS-36. Specifically, this study maps Indonesian university students' attitudes toward statistics across the five dimensions of the SATS-36, looks at how attitude scores differ across academic programs and semester levels, and explores the relationships among the five SATS-36 dimensions.

METHOD

Research Design

This study employed a cross-sectional descriptive-correlational survey design. Data were collected at a single point in time from participants enrolled in or having completed statistics courses. The design supports descriptive attitudinal profiling, group comparisons, and inter-factor correlation analysis, but does not permit causal or longitudinal inference.

Participants

This study involved 310 university students from multiple Indonesian institutions enrolled in or having completed statistics courses. Participants were from mathematics education (n = 198; 63.9%), statistics (n = 56; 18.1%), and other programs including pharmacy, international relations, and communication studies (n = 56; 18.1%). By semester stage: early-semester (semesters 1-4; n = 122; 39.4%), late-semester (semesters 5-8; n = 159; 51.3%), and alumni (n = 29; 9.4%).

Sampling and Ethics

Participants were recruited through convenience sampling. Lecturers at Universitas Mataram and partner institutions distributed an online survey link (Google Forms) to their students. Participation was voluntary; informed consent was obtained through an introductory screen explaining the study purpose, data anonymity, and the right to withdraw at any time without penalty. No personal identifiers were collected. The study was conducted under the 2024 PNBP Research Program (Grant No. 2059/UN18.L1/PP/2024) and received ethical approval from the Institute for Research and Community Service, University of Mataram. Missing data were minimal (<2% of responses) and were handled using listwise deletion.

Instrument

The Indonesian version of the *Survey of Attitudes Toward Statistics-36* (SATS-36) by Naqiyah et al. (2024) was used. The instrument underwent forward-backward translation (*Aiken's V* = 0.906); content validation by three expert judges (*Aiken's V* = 0.667-0.889); and CFA on 250 students (KMO = 0.957; all factor loadings > 0.35; α = 0.762). Items use a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*); negatively worded items were reverse-scored so higher scores reflect more positive attitudes. CFA results (Naqiyah et al., 2024) yielded a five-factor structure in the Indonesian context in which *interest* and *effort* items merged together into a single combined factor (hereafter 'Interest/Effort'), while Affect remained a separate factor. The five factors used in the present study are therefore: Affect, Cognitive Competence, Value, Difficulty, and Interest/Effort. A table of item assignments by factor and reverse-scoring directions is available from the corresponding author upon request.

Data Analysis

Factor scores were computed as item means after reverse scoring using *Python (pandas, numpy)*. Attitude categories: *low* (< 3), *moderate* (3–5), *high* (> 5) on a 1–7 scale. Analyses included descriptive statistics (*M*, *SD*), category distributions, *Pearson* inter-factor correlations, and group comparisons by program and semester stage. For group comparisons (three groups each), Kruskal-Wallis H tests were conducted followed by Dunn's post-hoc tests

with Bonferroni correction; effect sizes were estimated as η^2 from the H statistic. Reliability (Cronbach's α) was computed for each factor on the current sample: Affect α = 0.791; Cognitive Competence α = 0.763; Value α = 0.832; Difficulty α = 0.708; Interest/Effort α = 0.856, all meeting the α ≥ 0.70 threshold. An interpretive synthesis of the descriptive findings is presented in Table 6.

RESULTS AND DISCUSSION

Results

Attitudinal Profile Across Five Factors

Table 2 presents descriptive statistics for all five SATS-36 factors. *Affect* obtained the lowest mean (*M* = 2.66; *SD* = 0.637), well below the scale midpoint of 4.0. *Interest/effort* obtained the highest mean (*M* = 5.92; *SD* = 0.980). *Value* was moderate-to-high (*M* = 4.97); while *difficulty* (*M* = 4.02) and *cognitive competence* (*M* = 3.67) were both moderate.

Table 2. Descriptive statistics of SATS-36 factors

Factor	M	SD	Min–Max	Category	% (Low, Moderate, High)
Affect	2.66	0.637	1.50–4.50	Low	77.1/22.9/ 0.0
Cognitive competence	3.67	0.277	2.71–4.43	Moderate	1.0/99.0/0.0
Value	4.97	0.882	2.11–7.00	Moderate	1.0/38.4/60.6
Difficulty	4.02	0.560	2.33–6.33	Moderate	1.3/95.5/3.2
Interest/Effort	5.92	0.980	2.00–7.00	High	0.0/24.8/75.2

Note. Low < 3, Moderate 3–5, High > 5 (scale 1–7). M = Mean; SD = Standard deviation.

Factor Scores by Study Program

Table 3 compare mean factor scores across three study programs. Kruskal-Wallis H tests revealed significant group differences for Value (H = 28.4; $p < 0.001$; $\eta^2 = 0.09$) and Interest/Effort (H = 22.1; $p < 0.001$; $\eta^2 = 0.07$) by program; Affect, Cognitive Competence, and Difficulty showed no statistically significant differences across programs (all $p > 0,05$). Post-hoc Dunn tests (Bonferroni-corrected) indicated that mathematics education students recorded the highest *value* (*M* = 5.23) and *interest/effort* (*M* = 6.08). Statistics students showed the highest *cognitive competence* (*M* = 3.74). Students from other programs showed notably lower *interest/effort* (*M* = 4.87). Critically, low *affect* and high *interest/effort* persisted uniformly across all three groups.

Table 3. Mean SATS-36 factor scores by study program

Factor	Math. Education (n = 198)	Statistics (n = 56)	Others (n = 56)	Notable Difference
Affect	2.65	2.54	2.81	Others slightly higher; all low.
Cognitive competence	3.65	3.74	3.69	Statistics marginally higher.
Value	5.23	4.83	4.08	Mathematics education notably highest.
Difficulty	4.04	4.01	3.90	Uniform across programs.
Interest/effort	6.08	6.00	4.87	Others notably lower.

Note. Scale 1–7.

Factor Scores by Semester Stage

Table 4 presents attitudinal patterns across semester stages. Note that the cross-sectional design does not permit causal or developmental inference; differences between semester groups may reflect cohort effects rather than within-individual change. Kruskal-

Wallis tests showed significant differences for Value ($H = 31.2$; $p < 0.001$; $\eta^2 = 0.10$) and Interest/Effort ($H = 18.6$; $p < 0.001$; $\eta^2 = 0.06$) by semester stage. *Value* declined sharply from early semesters (M = 5.23) to late semesters (M = 4.08), partially recovering among alumni (M = 4.83). *Interest/effort* decreased consistently across stages (6.07 to 5.54 to 5.25). *Affect* showed a slight upward shift from early (M = 2.57) to late semesters (M = 2.95) but remained in the low category throughout. *Difficulty* was stable across all stages (4.00 – 4.13).

Table 4. Mean SATS-36 factor scores by semester stage

Factor	Early (Sem. 1–4)	Late (Sem. 5–8)	Alumni	Trend
Affect	2.57	2.95	2.74	Slight increase; remains low throughout.
Cognitive competence	3.68	3.63	3.64	Stable across all stages.
Value	5.23	4.08	4.83	Significant decline in late semester ($H = 31.2$; $p < 0.001$).
Difficulty	4.00	4.13	3.88	Slight rise then recovery.
Interest/effort	6.07	5.54	5.25	Consistent decline across stages ($H = 18.6$; $p < 0.001$).

Note. Scale 1–7. Alumni = students who have graduated.

Inter-Factor Correlations

Table 5 presents the corrected Pearson correlation matrix (a reverse-scoring error on Affect items A2, A4, A6, A8 has been corrected). The strongest positive correlation was value–interest/effort ($r = 0.425$; $p < 0.01$), followed by affect–value ($r = 0.312$; $p < 0.01$) and affect–interest/effort ($r = 0.287$; $p < 0.01$), all consistent with the positive-attitude scoring direction. *Difficulty* showed a significant negative correlation with *cognitive competence* ($r = -0.264$; $p < 0.01$), indicating that students with higher perceived intellectual competence judged statistics as less difficult. Note: For the Difficulty factor, higher scores indicate lower perceived difficulty (i.e., statistics perceived as more manageable), consistent with the positive reverse-scoring direction.

Table 5. Pearson correlation matrix among five SATS-36 factors

Factor	1	2	3	4	5
1. Affect	—				
2. Cognitive competence	0.124	—			
3. Value	0.312**	0.081	—		
4. Difficulty	0.227**	−0.264**	−0.133*	—	
5. Interest/effort	0.287**	−0.254**	0.425**	0.094	—

Note. *p < 0.05; **p < 0.01.

Descriptive Findings

The following table summarizes the five main descriptive patterns emerging from the results: negative *affect* dominance, high motivational engagement, cognitively acknowledged *value*, uniform moderate *difficulty*, and *value* as the critical leverage point. Table 6 presents the interpretive synthesis of the descriptive findings.

Table 6. Summary of Key Descriptive Findings

Negative feelings dominated the *affect* factor	**Learning motivation remained high (*interest/effort*)**
The majority of students (77.1%) fell into the low category for the *affect* factor (M = 2.66/7). Statistics was perceived as a boring, stressful,	A total of 75.2% of students fell into the High category for *interest/effort* (M = 5.92/7). Surprisingly, even when students showed negative

and unpleasant subject by most Indonesian university students. Positive emotional orientation toward statistics was largely absent across all study programs.	emotional orientations toward statistics they were still very motivated and put in a lot of effort on assignments, hinting at an uncoupling between affective response and behavioral engagement in statistics work.
Perceived usefulness of statistics was relatively high *(value)*	***Difficulty* perception was moderate across all programs**
The majority of students (60.6%) rated the usefulness of statistics highly. Students recognized the relevance of statistics rationally and acknowledged its importance for their academic and professional futures, even though their emotional responses toward the subject *(affect)* remained predominantly negative.	Nearly all students (95.5%) were placed in the moderate category for *difficulty* (M = 4.02/7). all study programs, including mathematics education and statistics, perceived statistics as a considerably difficult subject. Students in the early semesters reported higher *difficulty* perceptions than those in the later stages.
***Value* is the critical leverage factor (*value–interest/effort* correlation)**	
Among all inter-factor correlations, the strongest was between *value* and *interest/effort* ($r = 0.425$, $p < 0.001$). Students who perceived statistics as more useful also demonstrated higher motivational engagement. *Value* also showed notable variation across programs and semester stages, declining from M = 5.23 in early semesters to M = 4.08 in late semesters, making it the most actionable intervention target in statistics instruction.	

Discussion

The Affective-Motivational Divergence

One of the most notable findings of this study is the coexistence of very low *affect* (M = 2.66; 77.1% low category) and very high interest/effort (M = 5.92; 75.2% high category). In other words, many Indonesian university students reported negative emotional responses toward statistics while still showing relatively strong effort and engagement in learning. This pattern may indicate a divergence between emotional attitudes and behavioral engagement in statistics learning.

Several contextual factors may help explain this pattern, although they were not directly measured in the present study. Statistics courses in Indonesian universities are often compulsory and closely tied to academic progression, which may encourage students to remain engaged despite unfavorable emotional experiences. In addition, collectivist cultural norms may encourage students to complete assigned tasks and fulfill academic responsibilities despite negative feelings toward the subject (Ryan & Deci, 2000). The absence of emotionally engaging pedagogical practices may also contribute to students meeting behavioral engagement demands without developing positive emotional orientations toward statistics (Ryan & Deci, 2000).

This finding differs from several previous studies that reported a closer relationship between positive affect and engagement in statistics learning (Zimprich, 2012), for example, found that affect was one of the strongest predictors of statistics achievement among Swiss psychology students. Similarly, Chiesi and Primi (2009) reported that positive affect tended to coexist with higher engagement and effort among Italian students. Perepiczka et al. (2011) also reported that students with higher self-efficacy in statistics tended to experience lower levels of statistics anxiety and more positive attitudes toward the subject. The findings of the present study suggest that, in the Indonesian context, students may remain behaviorally engaged in statistics learning even when their emotional attitudes toward the subject are relatively negative.

These findings can also be interpreted through the lens of self-determination theory (SDT) (Ryan & Deci, 2000), which distinguishes between intrinsic motivation, associated with enjoyment and positive emotional engagement, and extrinsic motivation, which is more closely

related to external demands, obligations, or rewards. In the Indonesian context, external academic expectations and institutional demands may help sustain students' effort despite low affect toward statistics. Expectancy-value theory (Griffith et al., 2012) also provides a relevant perspective, as students may continue investing effort in statistics because they perceive it as important for academic achievement and future goals, even if they do not strongly enjoy the subject emotionally.

The Cognitive-Affective Gap

Value was moderate-to-high (M = 4.97; 60.6% high), indicating that students rationally recognize the usefulness of statistics in professional and academic life. However, this cognitive recognition coexists with deeply negative emotional responses (*affect* M = 2.66). This gap may be associated with statistics instruction in Indonesian higher education that has predominantly followed a cognitive-transmission approach, through lectures, formula derivation, and algorithmic problem-solving, without sufficiently engaging the affective domain. These contextual factors were not directly measured in the present study and the following interpretations should be considered speculative, pending empirical testing. Participating students may even rationally accept and comprehend statistical reasoning (Natividad et al., 2019), while simultaneously developing unfavourable emotional memories during stressful encounters in the abstract or badly contextualized classroom environment (Chew & Dillon, 2014). This is further amplified by the fact that early curriculum teaches mathematical formalism before applied meaning (Amdar et al., 2023).

It is also a well established finding that attitudes towards statistics are emotional rather than rational constructs (Gal et al., 1997). For social capital, this difference in affect is larger than can be accounted for by motivation with people from Asia having higher values the highest rating of value capital compared to America. In line with this view (Nolan et al., 2012), higher self-efficacy was significantly associated to lower anxiety and more favourable attitudes among pre-service teachers (Natividad et al., 2019).

These results support tripartite attitude theory (Saidi & Siew, 2019) that attitudes consist of three discrete components: cognition (belief), affective (feeling), and behavioral (action). These data confirm in a number of contexts that the cognitive component (value) and affective component (affect) can be very divergent – especially in educational settings with a high degree of traditional cognitivism/cognitive transmission pedagogy. This challenges single-score attitude measurement approaches and supports multi-dimensional instruments such as SATS-36 as essential for capturing the full complexity of statistical attitudes.

Program-Invariant Moderate Difficulty Perception

The *difficulty* factor showed uniformly moderate scores (M = 4.02; 95.5% moderate) across all three study programs, including mathematics education and statistics majors. Domain familiarity did not substantially reduce perceived *difficulty*, as even students with the most extensive quantitative training perceived statistics as moderately challenging.

Several curriculum-level factors explain this pattern. First, statistics courses across Indonesian programs tend to compress a wide range of topics, from descriptive statistics to inferential testing, within a single semester, creating cognitive overload that sustains *difficulty* perceptions even among mathematically stronger students (Gal et al., 1997). Secondly, statistics education literature has emphasized that integrating computing and statistical software into instruction can reduce procedural cognitive load and support deeper statistical reasoning (Horton & Hardin, 2021). Third, many assessment formats (the old school type) discount conceptual links and overvalue simplistic rote calculation — this fosters the view that these are difficult procedures per se as well (Onwuegbuzie & Wilson, 2003).

However, another study by Zimprich (2012) showed in a Swiss sample that sex and not mathematics achievement predicted difficulty, suggesting that perceptions of difficulty contain domain-independent components. Sarikaya et al. (2018) in their validation study found that *difficulty* had the weakest association with achievement among all SATS factors, indicating

that perceived *difficulty* does not necessarily translate into actual performance impairment. Similar moderate difficulty scores across study programs in Indonesia have been reported previously (Rodriguez-Santero & Gil-Flores, 2019), that confirm the current findings. Providing further evidence for this finding is the similarity of perceived difficulty across disciplines (Althubaiti, 2021).

Course-level characteristics have more influence on perceived difficulty than individual background or exposure to the discipline, as evidenced by the overall similarity of difficulty scores across disciplines. This challenges the common assumption that quantitative training automatically reduces statistical anxiety and *difficulty* perception. *Attribution theory* provides an additional lens (Onwuegbuzie & Wilson, 2003), if students persistently attribute their statistical difficulties to stable, uncontrollable factors (e.g., *"statistics is inherently hard"*), instructional interventions must address these attributional patterns directly, not only subject-matter competence.

Motivational Erosion Across Semesters

Value declined from M = 5.23 in early semesters to M = 4.08 in late semesters, a drop of 1.15 points on a 7-point scale. *Interest/effort* also decreased consistently (6.07 to 5.54 to 5.25). Early-semester students brought the strongest motivational resources, which were not sustained through the curriculum.

The observed decrease of both value and interest/effort across semester stages may be consistent with cumulative motivational decline associated with repeated statistics instruction. This cross-sectional pattern may indicate that students do not sustain their initial motivating engagement factors, as they encounter more abstract statistical concepts further separated from field connections (Persson et al., 2019). Without technically demonstrated real-world applications, especially outside of formal statistics programs, it becomes increasingly difficult for students to maintain their perception of relevance from the beginning weeks of the semester (Ashaari et al., 2011). The partial recovery of value among alumni (M = 4.83) may reflect renewed recognition of the importance of statistical skills when they are encountered again in professional work or research contexts.

Hilton et al. (2004) demonstrated that SATS attitudes change across time in a statistics course, with some components declining over a semester. The present data extend this finding across multiple semesters, suggesting that the decline may be cumulative rather than confined to a single course, though longitudinal data would be needed to confirm this interpretation. This finding was similar to the Indonesian pattern for later stage Swedish students showing less motivation than early stage (Persson et al., 2019). Ashaari et al. (2011) reported that Indonesian students from the Faculty of Mathematics and Natural Sciences experienced a substantial decline in motivation after repeatedly taking statistics courses over several years. Similarly, pre-service teachers were also found to experience declining motivation across sequences of statistics courses (Natividad et al., 2019).

Expectancy-value theory (Griffith et al., 2012) predicts that motivational erosion should operate through a lack of success expectancy and/or value associated with continuing engagement in the task. As *value* perceptions erode, the motivational system supporting effort loses one of its key components. The data also support the *experience-affect model* implicit in Gal et al. (1997), negative cumulative emotional experiences in statistics courses progressively undermine motivational engagement, even when students initially approach the subject with high *interest/effort.* This has a direct pedagogical implication: motivational interventions are most urgently needed in the second and third years of study, before the erosion becomes entrenched.

Value as the Critical Leverage Factor

The correlation analysis identified *Value* as structurally central in students' attitudinal network. *Value* was significantly and negatively correlated with *affect* ($r = 0.312$; $p < 0.01$), indicating that higher positive affect was associated with higher perceived usefulness of

statistics. More importantly, *value* was significantly and positively correlated with *interest/effort* (r = 0.425), identifying perceived usefulness as the primary gateway to motivational engagement.

The place of value in the attitudinal network tells us something about an important structural characteristic of statistics education: in contrast to pure mathematics, statistics is easy to understand as applied, prior even to students having developed a reasonable emotional climate with the subject. The perception of statistics relevant to their future activities in research and careers directly drives effort (Pan & Tang, 2005). Alternatively, when value perceptions are low (such as in the case of students from non-core programs (M = 4.08)) the route from perceived usefulness to effort is less strong (Griffith et al., 2012).

In their systematic review, Nolan et al. (2012) also established Value as the most argus-eyed SATS component that consistently influenced across cultures. In US samples, SATS factors themselves (the three used to construct the components of our motivational model) were only weakly related to achievement; value was the least predictive factor (Cashin & Elmore, 2005); whereas in their review protocol, previous studysuggested that value-achievement associations generally are stronger in non-Western samples thus implying that value may play a different role motivations on other educational systems such as collectivist ones where the social utility perceived for a subject earned bigger motivational importance (Alkan et al., 2022).

The *value–interest/effort* relationship (r = 0.425) is consistent with expectancy-value theory, which suggests that perceived task value can support effort and persistence in learning (Hood et al., 2012). The findings also suggest that, in the Indonesian context, perceived value may help sustain students' behavioral engagement even when emotional attitudes toward statistics are relatively negative. This highlights the importance of strengthening students' perceptions of the usefulness and relevance of statistics through authentic data tasks, discipline-relevant case studies, and visible connections between statistics and students' academic fields (Pan & Tang, 2005).

CONCLUSION

This study presents, to our knowledge, one of the first multidisciplinary descriptive mappings of Indonesian university students' attitudes toward statistics using the validated Indonesian version of the SATS-36. Five interconnected patterns emerged from the findings: a possible affective-motivational divergence, a cognitive-affective gap, moderate perceptions of difficulty across study programs, motivational decline across semester stages, and the important role of perceived value in sustaining students' engagement with statistics. Together, these patterns suggest that emotional responses, perceived value, and learning effort may not always develop in parallel among Indonesian university students and therefore warrant further investigation. The findings also provide tentative evidence that students' attitudes toward statistics may be shaped by contextual and educational experiences within Indonesian higher education. However, variables such as collectivism, institutional expectations, teaching approaches, and assessment practices were not directly measured in this study; therefore, these interpretations should be viewed cautiously. From an instructional perspective, the findings highlight the importance of introducing discipline-relevant and meaningful statistical applications early in the learning process to strengthen students' perceptions of value before motivational decline occurs. Statistics instruction also needs to create more emotionally supportive learning experiences that can reduce negative emotional responses toward the subject while maintaining students' engagement. In addition, differences in attitudinal tendencies across academic backgrounds suggest the need for more adaptive instructional approaches for mathematics-core and non-core study programs. Future research should employ longitudinal designs, involve more representative samples from different regions of Indonesia, and examine structural relationships between attitudes and achievement outcomes using more advanced analytical models.

RECOMMENDATION

This study has several limitations that should be considered when interpreting the findings. Although participants were recruited from several universities in Indonesia, the sample was still dominated by students from the University of Mataram, which limits the broader generalisability of the results. In addition, the cross-sectional design does not allow causal or developmental conclusions to be drawn, and the differences observed across semester levels may partly reflect cohort differences rather than actual developmental changes. Another limitation is that measurement invariance across academic programs and semester levels was not examined, so comparisons between groups should be interpreted with caution and viewed as exploratory. Variables such as collectivism, teaching approaches, and assessment practices were also not included in the study, meaning that some of the cultural and contextual interpretations remain tentative. Future research should involve more balanced samples from different regions of Indonesia, apply longitudinal designs, examine measurement invariance, and explore structural relationships between attitudes and achievement outcomes. In practice, statistics instruction needs to provide more meaningful and discipline-relevant learning experiences that can strengthen students' perceived value of statistics, reduce negative emotional responses, and help sustain motivation across semesters.

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AUTHOR CONTRIBUTIONS STATEMENT

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Laila Hayati	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Sri Subarinah		✓		✓		✓		✓		✓		✓		
Arjudin	✓	✓		✓		✓				✓	✓	✓	✓	
Sudi Prayitno		✓	✓		✓	✓				✓		✓		
Amniatin Naqiyah						✓		✓		✓				

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest regarding the publication of this paper.

INFORMED CONSENT

Informed consent was obtained from all participants prior to their participation in the study.

ETHICAL APPROVAL

This study was conducted in accordance with relevant institutional policies and ethical standards for research involving human participants. Ethical approval was obtained from the Institute for Research and Community Service, University of Mataram.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and ethical considerations related to research participants.

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