



Cadet Character Achievement in Aviation Vocational Education: Evidence from a Character-Based Non-Academic Assessment System

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Article History:

Submitted: 25-07-2026

Accepted: 03-08-2026

Published: 01-10-2026

Keywords:

Character Education; Aviation Cadets; Soft Skills Competency; Aviation Vocational Education; Character-Based Cadet Development.

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ABSTRACT

Character education is a crucial non-academic component in shaping professional and principled human resources for air transportation. This study aims to describe and compare the achievement of seven character dimensions among cadets (Religiosity and Morality, Integrity and Discipline, Responsibility and Work Ethic, Innovation and Critical Thinking, Effective Communication, Collaboration and Leadership, and Adaptability) based on the Non-Academic Assessment System (Sistem Penilaian Non Akademik/SPNA). The study employed a quantitative descriptive-comparative approach using individual scores of 159 cadets (population/census) across nine courses, extracted from the institution's official electronic assessment worksheets with institutional permission and data anonymization. Data were analyzed using descriptive statistics and non-parametric difference tests (Mann-Whitney U, Kruskal-Wallis) due to the skewed score distribution resulting from a ceiling effect, complemented by comparative parametric tests (Welch's t-test, ANOVA, Cohen's d) and Spearman correlation. The results show that the average character achievement of cadets was generally high, with Effective Communication and Collaboration and Leadership as the dimensions with the highest achievement, while Integrity and Discipline showed the greatest variation among cadets. The TPPU group (n = 52; M = 81.34), a priori grouped by study program, showed significantly lower achievement than the non-TPPU group (n = 107; M = 98.63) across all seven dimensions (p < .001; Cohen's d = 4.38, a very large effect). Semester level was significantly positively correlated with character achievement in both groups; however, the TPPU-non-TPPU gap remained substantial even at the highest available TPPU semester, indicating that course-specific factors also play a role beyond education duration alone. These findings recommend a more intensive evaluation of character-based cadet mentoring patterns in the TPPU course, particularly in the Integrity and Discipline and Responsibility and Work Ethic dimensions.

INTRODUCTION

Character education constitutes a core element of holistic education, fostering individuals who exhibit cognitive excellence, integrity, responsibility, and effective teamwork. Individuals possessing strong character are more likely to attain academic success, engage actively in non-academic pursuits, and demonstrate preparedness for workforce demands (More, 2026; Setiyatna & Mualim, 2024). Reinforcing character is especially vital in boarding-based vocational education, such as transportation cadet programs, where graduates are required to demonstrate both technical proficiency and mental resilience to function effectively in high-risk, discipline-intensive settings (Huda et al., 2024; Ubaidillah et al., 2020).

In the context of aviation vocational education in Indonesia, the strengthening of cadet character is formally regulated through the Standard for the Implementation of Character-Based Cadet Mentoring (PPSDMPU Perhubungan, 2022), issued by the Center for Air Transportation Human Resource Development (Pusat Pengembangan SDM Perhubungan Udara), Ministry of Transportation, as a derivative of Law Number 20 of 2003 on the National Education System and Presidential Regulation Number 87 of 2017 on Strengthening Character Education (Indonesia, 2017). This standard establishes a standardized non-academic assessment instrument, namely the Non-Academic Assessment System (Sistem Penilaian Non Akademik/SPNA), which encompasses the assessment of soft skill competencies across twelve character indicators (faith and piety, integrity, affection, forgiveness, work ethic, initiative, innovation and creativity, communication, teamwork, interpersonal relationships, adaptation, and discipline), combined with monthly commendation and violation scores (Suyatmo et al., 2024).

Based on the preceding context and literature, this study investigates three research questions: (1) How do cadets perform on the seven character dimensions as measured by the Non-Academic Assessment System? (2) How does character achievement differ across courses, and are there statistically significant differences between course groups?





(3) Is the character achievement gap related to semester level or specific to particular groups or courses? The study therefore aims to describe the achievement of seven cadet character dimensions across nine courses at Politeknik Penerbangan Makassar, evaluate the significance of achievement variation across courses, and identify gap patterns to inform the assessment of character-based cadet mentoring policies.

LITERATURE REVIEW

Character is conceptualized as a psychological strength that can be cultivated and developed through education and habituation, rather than existing solely as an inherent individual trait (Chen, 2022; Gander et al., 2020). Consistent with this perspective, Fransyaigu et al., (2021) (Umami et al., 2019) assert that character education is essential within the national education system, rather than being an optional supplement. Jose (2021) further contends that character education should be integrated with 21st-century skills, including critical thinking, communication, and collaboration, indicating that character achievement is inseparable from the broader development of non-academic competencies.

In the context of boarding-based vocational education, the mentoring philosophy widely adopted is derived from the thinking of Ki Hajar Dewantara, namely Ing Ngarso Sung Tulodo, Ing Madya Mangun Karso, and Tut Wuri Handayani, which emphasizes the balance between the transformation of knowledge and the transformation of values in the education process (Ningrum et al., 2025). This principle forms the philosophical foundation of the Among Asuh method, which is technically applied in cadet mentoring, as further elaborated in the Method section.

Maritime cadet education institutions frequently encounter an imbalance, prioritizing technical competence while character development and leadership training are less systematically integrated and assessed. Addressing this disparity necessitates intentional curricular reforms and instructional strategies that equally emphasize technical and character development (Frias et al., 2022; Timberg et al., 2025). Leadership, teamwork, adaptability, discipline, and integrity are recognized as critical character attributes for transportation professionals, although not all are explicitly referenced in the literature. Courage and honesty are less directly discussed but can be inferred as components of broader professional and ethical standards within the sector (Marinova-Stoyanova, 2024; Mirontseva et al., 2023). Authoritative parenting, characterized by a balance of firmness, empathy, and effective communication, is strongly linked to positive character development in students and cadets. Conversely, rigid parenting lacking warmth or open communication may impede the development of empathy, prosocial behavior, and overall character (Goering & Mrug, 2021; Karkanidis & Linardakis, 2025).

PBL-based soft skill assessment instruments in vocational education are characterized by their focus on real-world problem-solving, collaboration, and communication. They are more effective than traditional methods in capturing the comprehensive abilities required for modern workplaces, especially when supported by technology and multi-dimensional evaluation frameworks (Goering & Mrug, 2021; Mustofa et al., 2020), as well as a study of institutional practices in managing soft skill development in Indonesian vocational higher education (Fathudin et al., 2025). Specifically in the transportation sector, interpersonal and teamwork competencies have been identified as core competencies required of both educators and practitioners in the digital era (Yuen et al., 2022). Nevertheless, coordinating character education with technical curricula remains a complex challenge for educational institutions (Margerison & Ravenscroft, 2020).

Addressing the identified methodological gap is critical for several reasons. First, perception and survey data are prone to social desirability bias, particularly in boarding education environments with hierarchical structures. Objective caregiver assessments utilizing standardized instruments (SPNA) provide a more valid measure of character achievement. Second, although qualitative case studies offer contextual depth, they generally focus on single cohorts and are unable to capture achievement variation across courses or determine whether observed gaps are systematic or incidental. Third, quantitative mapping using official institutional data enables policymakers to identify courses or character dimensions requiring targeted intervention with greater precision than qualitative approaches. Nevertheless, quantitative research that systematically examines patterns and gaps in character achievement across courses and dimensions using official assessment data from boarding-based aviation education institutions remains scarce.

METHOD

This study employed a quantitative descriptive approach with a cross-sectional design based on non-academic assessment recapitulation data for cadet character aspects. The study population comprised all active cadets across nine courses from three study programs: Airport Technology (Teknologi Bandar Udara/TBU) (Batches XII, XII A, XIII, and XIV), Air Navigation Technology (Teknologi Navigasi Udara/TNU) (Batches XIV and XV), and Aircraft Maintenance Technology (Teknologi Pemeliharaan Pesawat Udara/TPPU) (Batches V, VI, and VII), totaling 159 cadets, all of whom served as the research subjects (population/census study) during the odd semester of the 2025/2026 academic year. The use of individual cadet character assessment data in this study received formal permission from the institution's leadership, and cadet identities were fully anonymized (replaced with subject codes) during data extraction, analysis, and reporting to protect personal data confidentiality. The grouping of cadets into TPPU and non-TPPU (combining TBU and TNU) categories was established a priori based on study program categories in accordance with the institution's curriculum structure, determined before data analysis; thus, this between-group comparison constitutes a planned comparison rather than the result of post-hoc exploration of data patterns (Sánchez et al., 2022).





The character assessment instrument refers to the Non-Academic Assessment System (SPNA) established in the Standard for the Implementation of Character-Based Cadet Mentoring (Center for Air Transportation Human Resource Development, 2022). The final monthly character score is calculated from a combination of three components: soft skill score (50% weight), commendation score (25% weight), and violation score (25% weight), which are subsequently accumulated into semester scores and grade-promotion scores. The twelve character indicators in the SPNA (as listed in Chapter III of the Standard for the Implementation of Character-Based Cadet Mentoring) are operationally grouped by the institution into seven dimensions used in this study's data recapitulation: (1) Religiosity and Morality, (2) Integrity and Discipline, (3) Responsibility and Work Ethic, (4) Innovation and Critical Thinking, (5) Effective Communication, (6) Collaboration and Leadership, and (7) Adaptability.

The mentoring method underlying cadet character formation refers to the educational philosophy of Ki Hajar Dewantara: Ing Ngarso Sung Tulodo (leading by example), Ing Madya Mangun Karso (building spirit from within), and Tut Wuri Handayani (encouraging from behind), which emphasizes the balance between knowledge transformation and value transformation in the education process (Ningrum et al., 2025). These three principles are technically implemented through the Among Asuh method (mutual honing, mutual affection, mutual mentoring). Assessments were conducted by direct caregivers (Battalion, Company, and Platoon Caregivers) through observation, recording, and documentation of cadets' daily behavior, and validated by indirect caregivers (lecturers, education staff, and institutional officials) in accordance with the institution's standard procedures (PPSDMPU Perhubungan, 2022).

Research data were obtained from the institution's official electronic non-academic assessment recapitulation worksheet (Microsoft Excel workbook), which contains each cadet's score on every SPNA indicator item along with the percentage subtotal per dimension, automatically calculated using the institution's standard formula. Accordingly, the unit of analysis in this study is the individual cadet ($N = 159$), not course-level aggregates. The accuracy of the data extraction was validated by comparing the mean of each dimension calculated from individual scores against the official mean stated in the institution's summary recapitulation sheet; the validation showed a high degree of agreement, with a maximum absolute difference of 1.43 points (on a 0-100 scale) across 63 course-dimension combinations, attributable to display rounding in the source document (Manggaberani et al., 2023). It should be noted as a limitation that the non-academic data collection dates in the source document were not uniform across courses (ranging from October 2025 to February 2026); therefore, this study is more accurately characterized as a near-concurrent cross-sectional study rather than a fully simultaneous single snapshot.

Data were analyzed using descriptive statistics (mean, standard deviation, range) to map achievement across dimensions and courses. The Shapiro-Wilk normality test showed that the score distributions in both the TPPU and non-TPPU groups deviated significantly from a normal distribution ($p < .001$ for both), as is common for assessment instruments with a strong ceiling effect. Therefore, between-group difference testing used the non-parametric Mann-Whitney U test (accompanied by rank-biserial correlation effect size) for two-group comparisons (TPPU vs. non-TPPU), and the Kruskal-Wallis test for comparisons across more than two groups (across nine courses), supplemented by comparative parametric tests (Welch's t-test, one-way ANOVA, and Cohen's d) for methodological transparency. The Mann-Whitney U test for the TPPU vs. non-TPPU comparison used a one-tailed hypothesis established a priori, because institutional mentoring records and caregiver field reports before this study consistently indicated a specific direction of the gap (higher achievement for non-TPPU), so the test direction was not derived from observing this study's data pattern. The relationship between semester level and character achievement was tested using Spearman correlation, both for the overall sample and separately within each course group, to detect possible confounding between course group and semester level. Data processing was conducted using Python (pandas, scipy, and openpyxl libraries).

RESULT

Character Achievement by Dimension

Descriptive statistics for the achievement of the seven character dimensions at the individual level are presented in Table 1.

Table 1. Descriptive Statistics of Cadet Character Achievement by Dimension ($N = 159$ Cadets)

Character Dimension	Mean	SD	Min	Max
Religiosity and Morality	96,86	8,63	66,67	100,0
Integrity and Discipline	87,11	19,21	33,33	100,0
Responsibility and Work Ethic	89,67	14,72	42,86	100,0
Effective Communication	92,70	10,89	60,00	100,0
Collaboration and Leadership	98,32	7,06	66,67	100,0
Adaptability	97,69	5,70	75,00	100,0
Effective Communication	88,47	11,55	50,00	100,0

Table 1 indicates that cadets' character achievement was generally high, with all dimensions averaging above 85 on a 100-point scale. Effective Communication ($M = 98.32$; $SD = 7.06$) and Collaboration and Leadership ($M = 97.69$;





SD = 5.70) exhibited the highest mean scores and the least variation. In contrast, Integrity and Discipline (M = 87.11; SD = 19.21) demonstrated the greatest variability, with a range of 66.67 points (individual scores from 33.33 to 100), followed by Adaptability (M = 88.47; SD = 11.55) and Responsibility and Work Ethic (M = 89.67; SD = 14.72).

Character Achievement by Course and Between-Group Difference Test

The mean and standard deviation of achievement across the seven character dimensions, calculated from individual scores within each course, are presented in Table 2.

Table 2. Mean and Standard Deviation of Cadet Character Achievement by Course

Course	Semester	n	Mean	SD
TBU XIV	1	24	99,80	0,67
TBU XII	4	24	99,40	1,61
TBU XII A	4	14	99,32	1,73
TBU XIII	3	8	99,11	1,77
TNU XIV	3	11	97,62	0,00
TNU XV	1	26	96,74	2,01
TPPU V	5	14	84,88	6,34
TPPU VI	3	10	82,59	3,21
TPPU VII	1	28	79,13	6,41

Table 2 demonstrates a distinct grouping pattern: TBU (XII, XII A, XIII, XIV) and TNU (XIV, XV) courses consistently achieved mean scores above 96 with minimal standard deviations (0.00–2.01). Conversely, the three TPPU courses (V, VI, VII) recorded mean scores ranging from 79.13 to 84.88, accompanied by notably larger standard deviations (3.21–6.41).

The Mann-Whitney U test at the individual level (N = 159) showed that the non-TPPU group (n = 107; M = 98.63; SD = 1.92) had significantly higher overall character achievement than the TPPU group (n = 52; M = 81.34; SD = 6.35) (U = 5,564.0; p < .001, one-tailed), with a near-maximal effect size (rank-biserial r approaching -1). The comparative Welch's t-test yielded a consistent conclusion (t = 19.22; p < .001) with Cohen's d = 4.38, far exceeding the conventional threshold for a large effect size (d = 0.8). The Kruskal-Wallis test across all nine courses also revealed a highly significant difference (H = 137.52; p < .001), confirmed by one-way ANOVA (F = 104.84; p < .001).

Testing across the seven character dimensions (Table 3) was conducted without correction for multiple comparisons (e.g., Bonferroni); however, because all p-values across the seven dimensions fell far below the most conservative corrected threshold ($\alpha/7 = .0071$), applying such a correction would not change the significance conclusion for any single dimension. The Kruskal-Wallis and one-way ANOVA tests above serve as omnibus tests confirming the general presence of variation across courses; pairwise post-hoc tests between courses (e.g., Dunn's test) were not the focus of this study, as the primary comparison analyzed, TPPU vs. non-TPPU, was established a priori based on study program category as explained in the Method section, rather than resulting from post-hoc exploration of data patterns.

Further analysis of each dimension (Table 3) shows that the TPPU vs. non-TPPU gap was consistently significant across all seven character dimensions, with the largest gaps found in Integrity and Discipline (a difference of 33.24 points) and Responsibility and Work Ethic (a difference of 29.96 points), while the smallest gap occurred in Effective Communication (a difference of 5.13 points).

Table 3. Comparison of Mean Scores per Dimension between the Non-TPPU and TPPU Groups

Character Dimension	M Non-TPPU (n=107)	M TPPU (n=52)	p (Mann-Whitney U)
Religiosity and Morality	99,84	90,71	<0,001
Integrity and Discipline	97,98	64,74	<0,001
Responsibility and Work Ethic	99,47	69,51	<0,001
Innovation and Critical Thinking	99,81	78,08	<0,001
Effective Communication	100,00	94,87	<0,001
Collaboration and Leadership	99,84	93,27	<0,001
Adaptability	93,46	78,21	<0,001

Contrary to initial assumptions based on aggregate course-level data, the Spearman correlation test at the individual level (N = 159) showed a significant, albeit weak, positive relationship between semester level and overall character achievement ($\rho = .185$; p = .020). To test whether this relationship was consistent or merely a result of differing semester compositions across groups (TBU and TNU were distributed across semesters 1, 3, and 4, while TPPU spanned semesters 1, 3, and 5), the correlation was retested separately within each group. The results showed an even stronger positive correlation in both groups: non-TPPU ($\rho = .314$; p = .001; n = 107) and TPPU ($\rho = .577$; p < .001; n = 52). The gap between TPPU and non-TPPU remained substantial even at the highest available semester point for TPPU: TPPU course V at semester 5 (M = 84.88) remained far below TNU course XV at semester 1 (M = 96.74),



the lowest-achieving course within the non-TPPU group.

DISCUSSION

The high achievement in Effective Communication and Collaboration and Leadership aligns with the boarding-based mentoring curriculum's emphasis on group activities, roll calls, and cadet corps events that promote social interaction. This finding is consistent with evidence that team-based work environments in the transportation sector require strong interpersonal skills (Altaher et al., 2024; Lehmann-Willenbrock & Hemshorn De Sanchez, 2024; Yuen et al., 2022). Collective mentoring strategies, including barracks living and group activities, effectively foster these competencies, even in courses with lower overall achievement. Notably, the gap in Effective Communication between groups was only 5.13 points, considerably smaller than the gaps observed in other dimensions.

Conversely, the substantial gaps in Integrity and Discipline and Responsibility and Work Ethic, particularly within the TPPU course group, warrant focused attention due to their statistical significance and large effect size (Cohen's $d = 4.38$). This pattern aligns with previous research indicating that the implementation of character education in transportation vocational institutions often diverges from programmatic ideals (Rahayu et al., 2024), potentially due to variations in mentoring intensity, caregiver-to-cadet ratios, or cohort demographics. The statistically significant but limited correlation between semester level and character achievement suggests that course-specific factors, such as mentoring strategies, cadet composition, or violation history, have a greater impact than education duration alone. Although the individual-level statistical significance ($N = 159$) demonstrates a consistent pattern, additional data are necessary to identify the underlying causal mechanisms, as discussed in the Method section.

The difficulty of integrating character education with technical curricula (Margerison & Ravenscroft, 2020; Pierrakos et al., 2021) may explain the greater variability observed in dimensions requiring sustained individual consistency, such as Integrity and Discipline and Responsibility and Work Ethic, compared to those developed through structured collective activities, such as Communication and Collaboration. The positive correlation between semester level and character achievement within each group supports the perspective that character formation is a gradual developmental process throughout education (Park & Peterson, 2009; Zahra et al., 2024). This result suggests that implementing more intensive mentoring interventions during the early stages of the TPPU course could help reduce this gap.

CONCLUSION

This study examined and compared the character achievement of 159 cadets across nine courses at Politeknik Penerbangan Makassar, focusing on seven character dimensions assessed by the Non-Academic Assessment System (SPNA). Cadets generally exhibited high character achievement, with Effective Communication and Collaboration and Leadership as the highest and most consistently distributed dimensions, while Integrity and Discipline showed the greatest variability. The TPPU group demonstrated significantly lower achievement than the TBU and TNU groups across all seven dimensions (Mann-Whitney U test, $p < .001$; Cohen's $d = 4.38$). Semester level was positively correlated with character achievement both overall and within each group, indicating ongoing character development; however, this correlation did not fully explain the persistent TPPU-non-TPPU gap, suggesting the influence of course-specific factors beyond education duration. These findings underscore the need for a more adaptive and intensive evaluation of mentoring strategies in the TPPU course, particularly regarding Integrity and Discipline and Responsibility and Work Ethic. Further research utilizing a mixed-methods approach is recommended to investigate the underlying causes of this gap.

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