Appendixes

Appendix A: Questionnaire (China College Student Survey-Based Instrument)

This appendix presents the complete questionnaire used for quantitative data collection in this study. The questionnaire was adapted from the China College Student Survey (CCSS) framework and consists of three parts: (1) Personal Background Information, (2) Learning Engagement Scale, and (3) Influencing Factors Scale. The questionnaire was administered to 503 undergraduate students at Hubei Enshi College.

Table 13: Interview outline for undergraduate students' learning engagement at Hubei Enshi College

Serial Number	Topic
1	Is there a learning experience that made you feel happy or a sense of belonging?
2	Have you ever felt like giving up or feeling depressed due to setbacks or pressure? What was the reason?
3	Which teacher had the greatest influence on your studies? Why?
4	Would you like to study with classmates? Why?
5	Do you think the school's learning resources (library, laboratories, internship opportunities, etc.) are sufficient?
6	Does your family support your studies or put pressure on you?
7	What impact will society's employment pressure have on your studies?
8	Are there other aspects that may affect your commitment to learning?

Table 14: Basic personal information of the respondents

Serial number	Item
1	Gender: □ Male □ Female
2	Number of siblings: □ None □ 1 □ 2 □ 3
3	Place of origin: □ City □ County □ Rural
4	Grade: □ Freshman □ Sophomore □ Junior □ Senior □ Big Five

5	Major Category: □ Medicine ☐ Engineering ☐ Science ☐ Liberal Arts ☐ Arts □Other
6	Have you ever served as a class leader? □ Yes □ No

Table 15: Learning engagement of the respondents

Dimensions	Observation point	Item	serial number	
Learning behavior engagement (B)	Classroom participation behavior	Listen attentively	1. I pay full attention and concentrate on the class: □ Always □ Often □ Sometimes □ Never	B1
		Class Notes	2. I take notes in class: □ Always □ Often □ Sometimes □ Never	B2
		Actively speak up	3. I actively participate in class discussions: □ Always □ Often □ Sometimes □ Never	B3
	Extracurricular learning behavior	Complete your homework	4. I complete my coursework and study assignments diligently: □ Always □ Often □ Sometimes □ Never	B4
		Deepening understanding	5. I think deeply about the course content and the questions the teacher asks: □ Always □ Often □ Sometimes □ Never	B5
		Summary	6. I summarize what I have learned in a timely manner: □ Always □ Often □ Sometimes □ Never	B6
Learning cognitive engagement (A)	Deep processing capabilities	Association Migration	7. I can relate what I learn in class to my previous knowledge and experience: □ Always □ Often □ Sometimes □ Never	A1
		Knowledge Fusion	8. I can integrate what I have learned from different courses to solve problems: □ Always □ Often □ Sometimes □ Never	A2
		Filter information	9. I can identify valuable content from a large amount of material: □ Always □ Often □ Sometimes □ Never	A3
	Multidimensional	Diversified thinking	10. I can consider issues from different perspectives: □ Always □ Often □ Sometimes □	A4

	thinking		Never	
		critical thinking	11. I can use reasoned evidence to judge whether other people's opinions or conclusions are correct: □ Always □ Often □ Sometimes □ Never	A5
	Metacognitive regulation ability	Reflection and Correction	12. I can reflect on and adjust my existing views on a certain issue: □ Always □ Often □ Sometimes □ Never	A6
		self-assessment	13. I can reflect on the strengths and weaknesses of my learning process: □ Always □ Often □ Sometimes □ Never	A7
Learning emotional engagement (C)	Learning motivation orientation	Stimulate interest	14. What I learned sparked my interest and curiosity: □ Very much □ Somewhat □ Not much □ Not at all	C1
		Intrinsic learning	15. I hope to master the material well, even if it doesn't show up in my grades: □ Very much □ Somewhat □ Not much □ Not at all	C2
		Intrinsic motivation	16. I hope to gain a sense of self-achievement by achieving good grades: □ Very influential □ Somewhat influential □ Not much influential □ Not influential at all	C3
	Achievement-oriented consciousness	Emphasis on evaluation	17. I hope to gain recognition and respect from others by achieving good grades: □ Very much □ Somewhat □ Not much □ Not at all	C4
		Awareness of striving for excellence	18. I hope to gain an advantage in honors evaluation, further education, or employment by achieving good grades: □ Very influential □ Somewhat influential □ Not much influential □ Not at all influential	C5
	Emotional perception experience	Learning stress perception	19. If I cannot complete the course requirements or face failure, I will feel guilty or anxious: □ Very much □ Somewhat □ Not much □ Not at all	C6

Table 16: Factors affecting learning engagement of respondents

Dimensions	Observation point	Item	serial number	
Student individual factors	Learning motivation and beliefs	Growth-oriented	1. I think what I have learned can help me achieve better development : □ Very consistent □ Somewhat consistent □ Not consistent □ Very inconsistent	S1
		Learning Confidence	2. I have the confidence to face unknown learning challenges : □ Very true □ Somewhat true □ Not true □ Very false	S2
		Learning resilience	3. I will not give up when I encounter difficulties or setbacks in my studies : □ Very true □ Somewhat true □ Not true □ Very false	S3
		Growth Beliefs	4. I believe that hard work will pay off : □ Very consistent □ Somewhat consistent □ Not consistent □ Very inconsistent	S4
		Learning first	5. I am able to put my study plan into practice : □ Very consistent □ Somewhat consistent □ Not consistent □ Very inconsistent	S5
	Learning behavior performance	Self-study time	6. Average daily study outside of class (preparing, reviewing, doing homework, reading, etc.): □ 0 hours □ 1 – 2 hours □ 2 – 4 hours □ 5 hours or more	S6
		Practice time	7. Average weekly internships related to career development : □ 0 hours □ 1 – 5 hours □ 6 – 10 hours □ 11 – 15 hours □ 16 – 20 hours □ 21 – 30 hours □ 30 hours or more	S7
		Activity duration	8. Average weekly participation in clubs, volunteer activities, and other activities : □ 0 hours □ 1 – 5 hours □ 6 – 10 hours □ 11 – 15 hours □ 16 – 20 hours □ 21 – 30 hours □ 30 hours or more	S8
	Professional attitude recognition	Professional Recognition	9. The more I learn about my major, the more I like it : □ Very consistent □ Somewhat consistent □ Not consistent □ Very inconsistent	S9

		competence perception	10. My university studies have enabled me to be competent for work in related fields : □ Very appropriate □ Somewhat appropriate □ Not very appropriate □ Very unsuitable	S10
Teacher factors	Teaching implementation quality	Teaching organization	11. The teacher is responsible and conscientious in teaching. The course objectives are clear, and the lectures are well-organized: □ Completely achieved □ Basically achieved □ Achieved some □ Did not achieve	T1
		Teaching Methods	12. The teacher guides and promotes meaningful classroom discussions, encourages us to question boldly, and provides me with space and support for independent exploration: □ Completely □ Mostly □ Achieve some □ Not at all	T2
		Teaching Evaluation	13. Teachers focus on assessing students' daily performance and their ability to solve practical problems: □ Strongly agree □ Somewhat agree □ Disagree □ Strongly disagree	T3
	Teaching communication feedback	Teaching Feedback	14. The teacher's timely feedback on the assessment results helped me know how to improve my learning and strengthened my confidence in learning: □ Strongly agree □ Somewhat agree □ Disagree □ Strongly disagree	T4
	Developmental support	Career Exchange	15. How often do teachers discuss career planning with me? □ Always □ Often □ Sometimes □ Never	T5
		Academic Exchange	16. How often do teachers discuss academic issues with me? □ Always □ Often □ Sometimes □ Never	T6
		Value guidance	17. How often do teachers discuss their outlook on life and values with me? □ Always □ Often □ Sometimes □ Never	T7
		Academic Support	18. How often do teachers participate in research projects, innovative practices, and other activities with us? □ Always □ Often □ Sometimes □ Never	T8
Peer factors	Collaboration support	Group collaborati	19. How often do I complete homework or study tasks with my classmates? □ Always □ Often □	P1

		on	Sometimes □ Never	
		Provide learning assistance	20. I discuss learning problems and exchange learning experiences with my classmates: □ Always □ Often □ Sometimes □ Never	P2
		Collaborative Practice	21. I participate in extracurricular activities with my classmates ? □ Always □ Often □ Sometimes □ Never	P3
Campus environmental factors	Learning service system	Experimental resource guarantee	22. The number and functions of instruments and equipment, as well as the supply of consumables, are sufficient to meet the needs of students' experimental training: □ Strongly agree □ Somewhat agree □ Somewhat disagree □ Strongly disagree □ Not involved/Unclear	U1
		Internship platform support	23. The internship base has a complete working environment and facilities that can meet the internship needs: □ Strongly agree □ Somewhat agree □ Somewhat disagree □ Strongly disagree □ Not involved/Unclear	U2
		Digital resource support	24. Using digital teaching platforms can help me better participate in classroom interactions and enhance my learning experience : □ Strongly agree □ Somewhat agree □ Somewhat disagree □ Strongly disagree □ Not involved/Unclear	U3
		Academic Support Services	25. Providing academic support (e.g., establishing an academic guidance center, writing center, or workshop, etc.): □ Very good □ Good □ Average □ Poor □ Not sure	U4
	Student protection mechanism	Financial Aid Guarantee	26. Providing financial support (such as providing on-campus assistant positions, fair evaluation of scholarships, etc.): □ Very good □ Good □ Average □ Poor □ Don't know	U5
		Physical and mental health	27. Providing physical and mental health support (such as medical care, psychological counseling, etc.): □ Very good □ Good □ Average □ Poor □ Don't understand	U6

	support		
Educational cultural atmosphere	Scientific and technological innovation atmosphere	28. Encourage students to participate in innovative research or practice (such as undergraduate innovation training programs, entrepreneurship competitions, or scientific and technological innovation competitions, etc.) : □ Strongly agree □ Somewhat agree □ Disagree □ Strongly disagree	U7
	Moral Development	29. Emphasize good personal qualities such as honesty, trustworthiness, and charity : □ Strongly agree □ Somewhat agree □ Disagree □ Strongly disagree	U8
	Diversity and Fusion	30. Encourage students from different countries, nationalities, regions, and family backgrounds to communicate with each other : □ Strongly agree □ Somewhat agree □ Disagree □ Strongly disagree	U9
	interdisciplinary	31. Encourage students from different majors to communicate with each other : □ Strongly agree □ Somewhat agree □ Disagree □ Strongly disagree	U10
Development path support	Personalized development	32. Encourage different types of career paths (academic elites, entrepreneurial youth, social worker experts, volunteer service leaders, skilled professionals, cultural and sports stars, etc.) : □ Strongly agree □ Somewhat agree □ Disagree □ Strongly disagree	U11
	Meta-growth channel	33. Provide rich learning resources (such as dual degrees, overseas exchange, etc.) to support individual development : □ Strongly agree □ Somewhat agree □ Disagree □ Strongly disagree	U12
	Employment support services	34. Providing employment support (such as organizing employment consultations, career seminars or workshops, etc.): □ Very good □ Good □ Average □ Poor □ Don't know	U13

	Participation and feedback mechanism	Feedback mechanism	35. Students have channels to give their opinions and suggestions to the school : □ Very good □ Good □ Average □ Poor □ Not sure	U14
Family environment factors	Family socioeconomic background	Parents' education level	36. What is the highest level of education your parents have? - Father / - Mother	F1
		Parents' occupation type	37. What are your parents' occupations? - Father / - Mother	F2
		Household income level	38. Your total household income last year was approximately	F3
	Family location structure characteristics	Home area attributes	39. Before going to college, where did your family live ? □ Municipality □ Provincial capital □ Prefectural-level city □ County town □ Township □ Rural area	F4
		Family household registration type	40. Before entering university, what was your household registration status ? □ Agricultural □ Non-agricultural □ Other, please specify:	F5
	Family education value orientation	Academic Expectations	41. What educational level do your parents hope you will achieve? □ Bachelor's degree □ Master's degree □ Doctorate □ No specific expectation	F6
		Employment expectations	42. What type of work unit do your parents hope you will work in in the future ? □ Party and government agencies □ State-owned enterprises □ Public institutions □ Foreign-owned enterprises or joint ventures □ Self-employment	F7
Social environmental factors	Employment pressure and	Career expectations	43. I am confident about the employment prospects of my major : □ Very consistent □ Somewhat consistent □ Not consistent □ Very inconsistent	E1

	guidance		
Social value orientation	Occupational affiliation	44. I am willing to work or study in a field related to my major : □ Very consistent □ Somewhat consistent □ Not consistent □ Very inconsistent	E2
	Social expectations and recognition	45. What I have learned will help me and my family have a better life in the future: □ Very influential □ Somewhat influential □ Not much influential □ Very uninfluential	E3
	Social responsibility awareness	46. What I have learned can help me make better contributions to society: □ Very influential □ Somewhat influential □ Not much influential □ Very uninfluential	E4
Perception of policy support	Perception of educational equity	47. The process of comprehensive quality assessment is fair and just, and can promote the diversified development of students : □ Completely achieved □ Basically achieved □ Achieved some □ Did not achieve	E5

Table 17: Structured interview outline for respondents

Serial Number	Item
1	Are you satisfied with your current learning status?
2	What are your favorite learning styles or methods?
3	How do you usually participate in classroom and extracurricular learning? What methods do you usually use?
4	Are you involved in any competitions, projects, or internships? How have they impacted you?
5	How do you understand and master complex content in your studies?
6	When faced with difficulties, how do you usually deal with them? What kind of help do you actively seek?
7	Are you satisfied with your current major and courses?

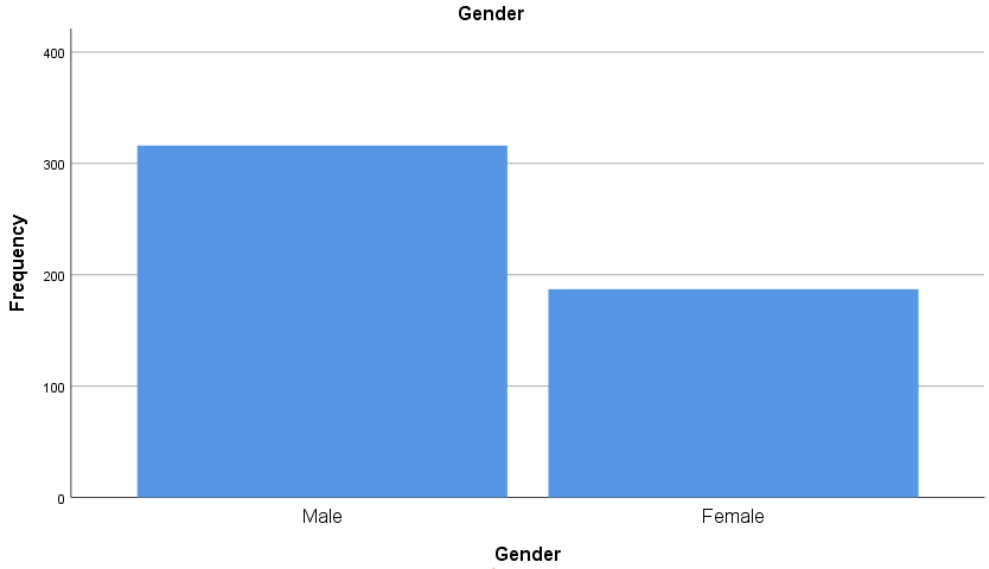
8	Have you had any learning experiences that made you feel happy or a sense of belonging?
9	Have you ever felt like giving up or feeling depressed due to setbacks or pressure? What was the reason?
10	Which teacher had the greatest influence on your studies? Why?
11	Would you like to study with classmates? Why?
12	Do you think the school's learning resources (library, laboratories, internship opportunities, etc.) are sufficient?
13	Does your family support your studies or put pressure on you?
14	What impact will society's employment pressure have on your studies?
15	Are there other aspects that may affect your commitment to learning?

Appendix B: Detailed Demographic and Background Characteristics of the Sample

This appendix presents the comprehensive demographic and background characteristics of the 503 valid respondents. Tables A1 through A15 provide detailed frequency distributions for all demographic variables. A concise summary of these characteristics is presented in Section 4.1.1 of the main text.

Table 18: Frequency Distribution of Respondents by Gender (N=503)

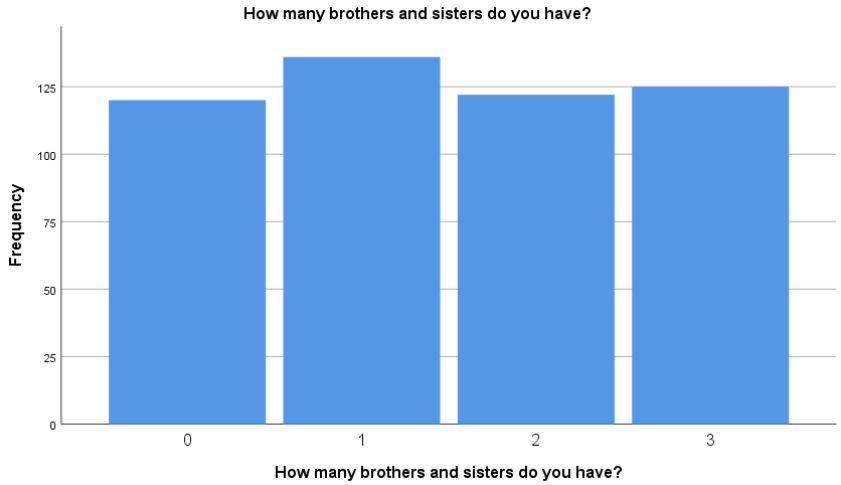
Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	316	62.8	62.8	62.8
	Female	187	37.2	37.2	100.0
	Total	503	100.0	100.0	



Picture 9: Gender Distribution

Table 19: Frequency Distribution of Number of Siblings (N=503)

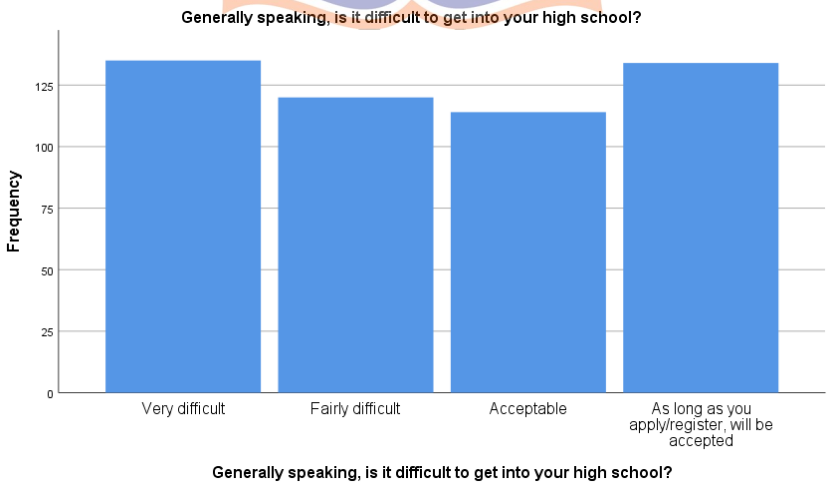
How many brothers and sisters do you have?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	120	23.9	23.9	23.9
	1	136	27.0	27.0	50.9
	2	122	24.3	24.3	75.1
	3	125	24.9	24.9	100.0
	Total	503	100.0	100.0	



Picture 10: Distribution of respondents by number of brothers and sisters.

Table 20: Frequency Distribution of Perceived High School Admission Difficulty (N=503)

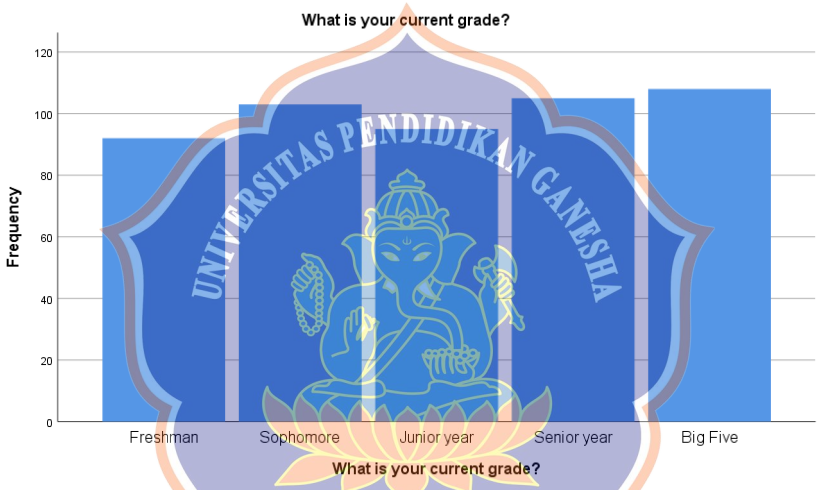
Generally speaking, is it difficult to get into your high school?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very difficult	135	26.8	26.8	26.8
	Fairly difficult	120	23.9	23.9	50.7
	Acceptable	114	22.7	22.7	73.4
	As long as you apply/register, you will be accepted	134	26.6	26.6	100.0
	Total	503	100.0	100.0	



Picture 11: Perceived difficulty of gaining admission to high school.

Table 21: Frequency Distribution of Respondents by Grade Level (N=503)

What is your current grade?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Freshman	92	18.3	18.3	18.3
	Sophomore	103	20.5	20.5	38.8
	Junior year	95	18.9	18.9	57.7
	Senior year	105	20.9	20.9	78.5
	Big Five	108	21.5	21.5	100.0
	Total	503	100.0	100.0	

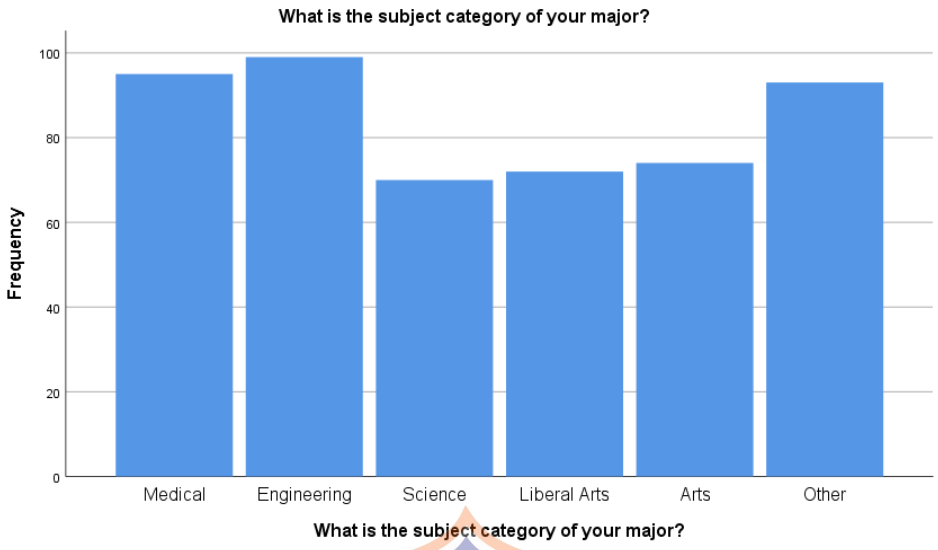


Picture 12: Distribution of respondents by current academic grade.

Table 22: Descriptive Statistics for Subject Area of Study.

What is the subject category of your major?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medical	95	18.9	18.9	18.9
	Engineering	99	19.7	19.7	38.6
	Science	70	13.9	13.9	52.5
	Liberal Arts	72	14.3	14.3	66.8
	Arts	74	14.7	14.7	81.5
	Other	93	18.5	18.5	100.0

	Total	503	100.0	100.0

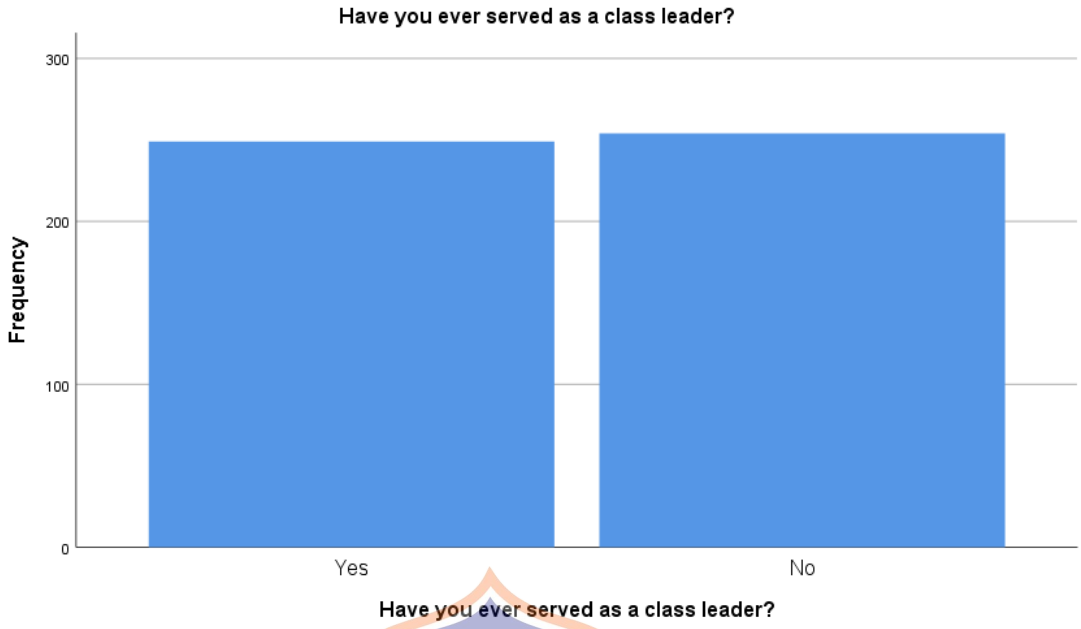


Picture 13: Breakdown of participants by major.

Table 23: Frequency Distribution of Leadership Experience (Class Leader) (N=503)

Have you ever served as a class leader?		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	249	49.5	49.5	49.5
	No	254	50.5	50.5	100.0
	Total	503	100.0	100.0	

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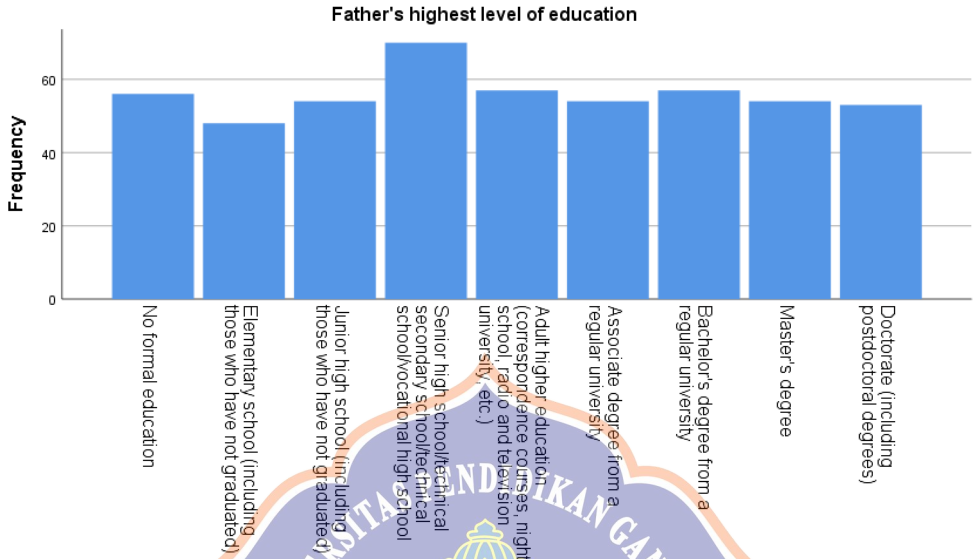


Picture 14: Distribution of student responses regarding prior experience as a class leader.

Table 24: Frequency Distribution of Father's Highest Education Level (N = 503)

Father's highest level of education		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No formal education	56	11.1	11.1	11.1
	Elementary school (including those who have not graduated)	48	9.5	9.5	20.7
	Junior high school (including those who have not graduated)	54	10.7	10.7	31.4
	Senior high school/technical secondary school/technical school/vocational high school	70	13.9	13.9	45.3
	Adult higher education (correspondence courses, night school, radio and television university, etc.)	57	11.3	11.3	56.7
	Associate degree from a regular university	54	10.7	10.7	67.4
	Bachelor's degree from a regular university	57	11.3	11.3	78.7
	Master's degree	54	10.7	10.7	89.5

	Doctorate (including postdoctoral degrees)	53	10.5	10.5	100.0
	Total	503	100.0	100.0	

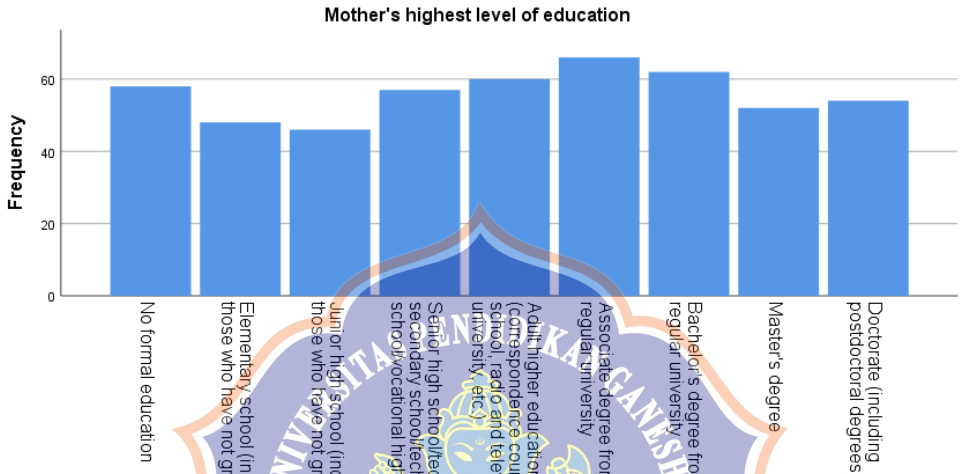


Picture 15: Distribution of respondents by educational attainment level.

Table 25: Maternal Education Level

Mother's highest level of education		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No formal education	58	11.5	11.5	11.5
	Elementary school (including those who have not graduated)	48	9.5	9.5	21.1
	Junior high school (including those who have not graduated)	46	9.1	9.1	30.2
	Senior high school/technical secondary school/technical school/vocational high school	57	11.3	11.3	41.6
	Adult higher education (correspondence courses, night school, radio and television university, etc.)	60	11.9	11.9	53.5
	Associate degree from a regular university	66	13.1	13.1	66.6

	Bachelor's degree from a regular university	62	12.3	12.3	78.9
	Master's degree	52	10.3	10.3	89.3
	Doctorate (including postdoctoral degrees)	54	10.7	10.7	100.0
	Total	503	100.0	100.0	

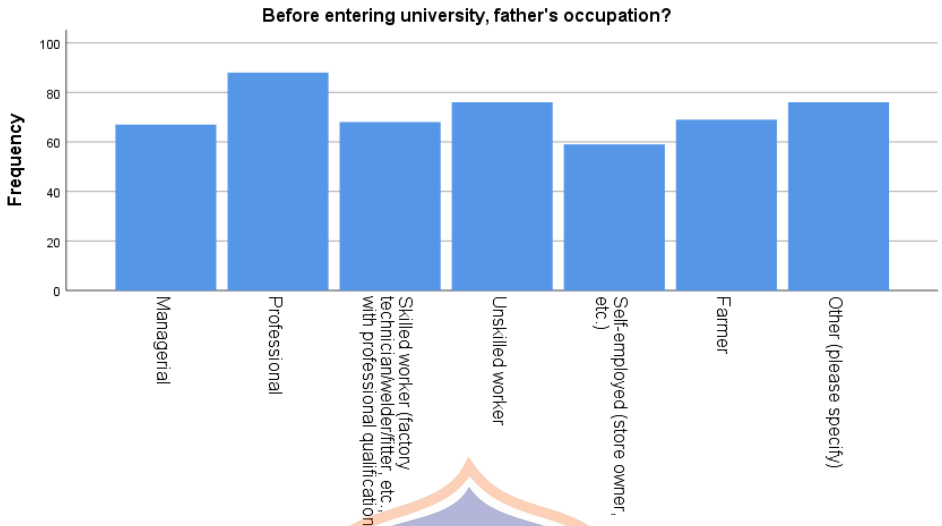


Picture 16: Frequency distribution of survey respondents by highest level of education completed.

Table 26: Paternal Occupation (Pre-University)

Before entering university, father's occupation?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Managerial	67	13.3	13.3	13.3
	Professional	88	17.5	17.5	30.8
	Skilled worker (factory technician/welder/fitter, etc., with professional qualifications)	68	13.5	13.5	44.3
	Unskilled worker	76	15.1	15.1	59.4
	Self-employed (store owner, etc.)	59	11.7	11.7	71.2
	Farmer	69	13.7	13.7	84.9
	Other (please specify)	76	15.1	15.1	100.0

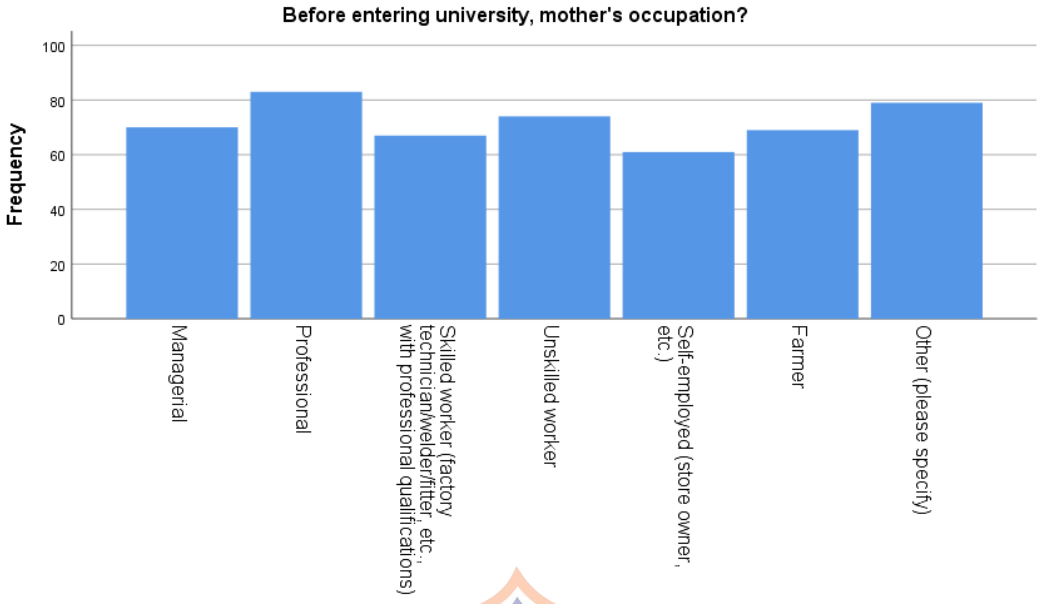
	Total		503	100.0	100.0



Picture 17: Bar chart showing the distribution of fathers' occupations before respondents entered university.

Table 27: Frequency Distribution of Mother's Occupation Before University (N = 503)

Before entering university, mother's occupation?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Managerial	70	13.9	13.9	13.9
	Professional	83	16.5	16.5	30.4
	Skilled worker (factory technician/welder/fitter, etc., with professional qualifications)	67	13.3	13.3	43.7
	Unskilled worker	74	14.7	14.7	58.4
	Self-employed (store owner, etc.)	61	12.1	12.1	70.6
	Farmer	69	13.7	13.7	84.3
	Other (please specify)	79	15.7	15.7	100.0
	Total	503	100.0	100.0	

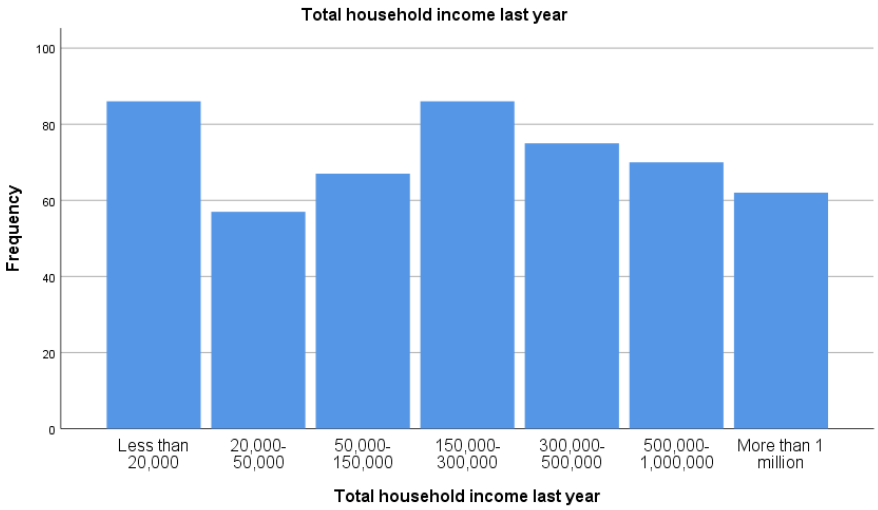


Picture 18: Distribution of mothers' occupations prior to respondents' university entrance.

Table 28: Frequency Distribution of Total Household Income (Last Year) (N = 503)

Total household income last year		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 20,000	86	17.1	17.1	17.1
	20,000-50,000	57	11.3	11.3	28.4
	50,000-150,000	67	13.3	13.3	41.7
	150,000-300,000	86	17.1	17.1	58.8
	300,000-500,000	75	14.9	14.9	73.8
	500,000-1,000,000	70	13.9	13.9	87.7
	More than 1 million	62	12.3	12.3	100.0
	Total	503	100.0	100.0	

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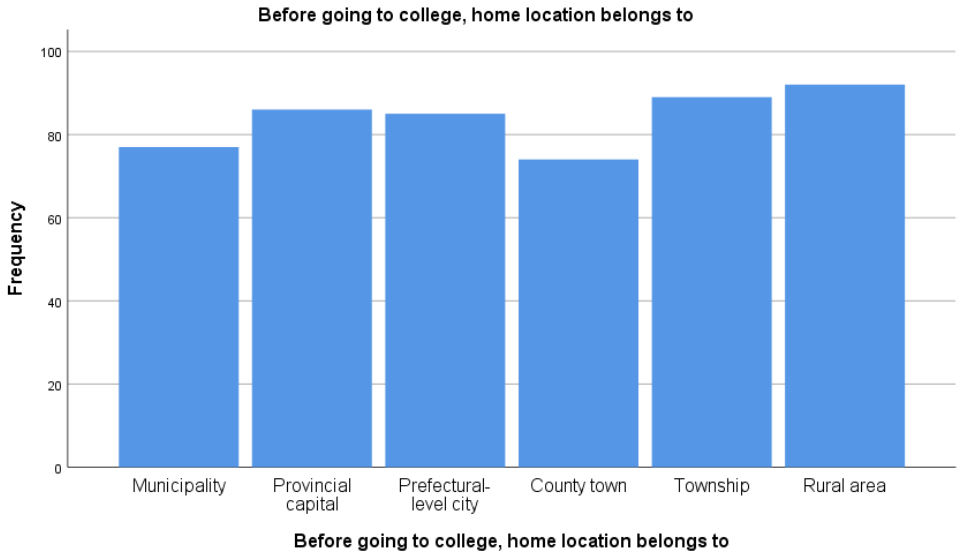


Picture 19: Frequency table of income brackets.

Table 29: Frequency Distribution of Pre-College Home Location (N=503)

Before going to college, home location belongs to		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Municipality	77	15.3	15.3	15.3
	Provincial capital	86	17.1	17.1	32.4
	Prefectural-level city	85	16.9	16.9	49.3
	County town	74	14.7	14.7	64.0
	Township	89	17.7	17.7	81.7
	Rural area	92	18.3	18.3	100.0
	Total	503	100.0	100.0	

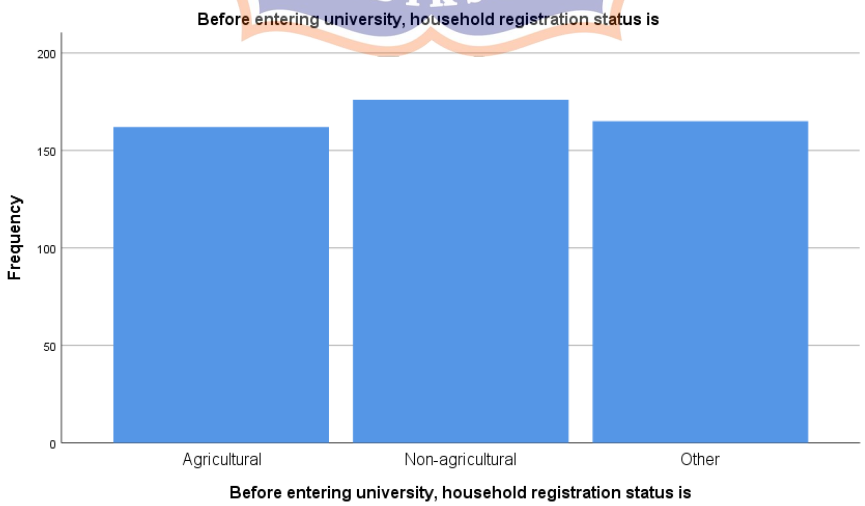
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Picture 20: Distribution of respondents by location of origin or residence.

Table 30: Frequency Distribution of Pre-University Household Registration Status (N = 503)

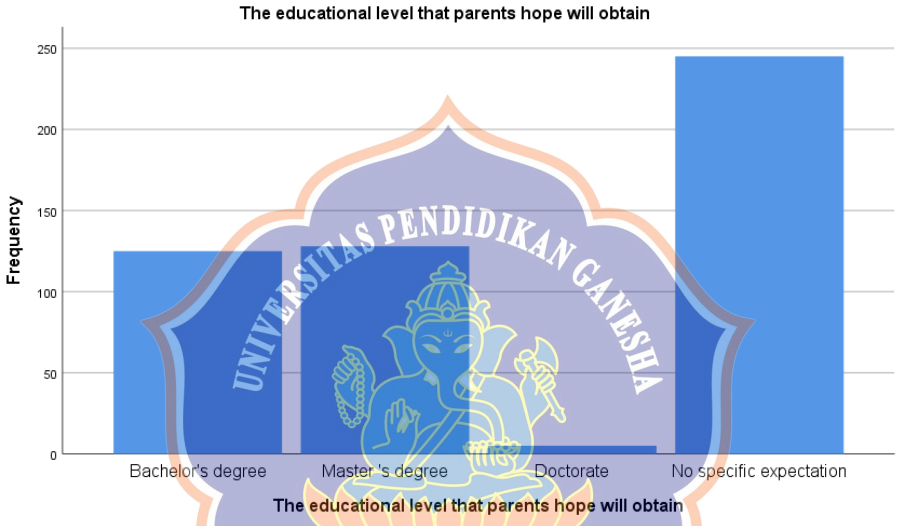
Before entering university, household registration status is		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agricultural	162	32.2	32.2	32.2
	Non-agricultural	176	35.0	35.0	67.2
	Other	165	32.8	32.8	100.0
	Total	503	100.0	100.0	



Picture 21: Bar chart showing the household registration status of respondents before university entrance.

Table 31: Distribution of Parental Educational Expectations for Their Children

The educational level that parents hope their children will obtain					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor's degree	125	24.9	24.9	24.9
	Master 's degree	128	25.4	25.4	50.3
	Doctorate	5	1.0	1.0	51.3
	No specific expectation	245	48.7	48.7	100.0
	Total	503	100.0	100.0	

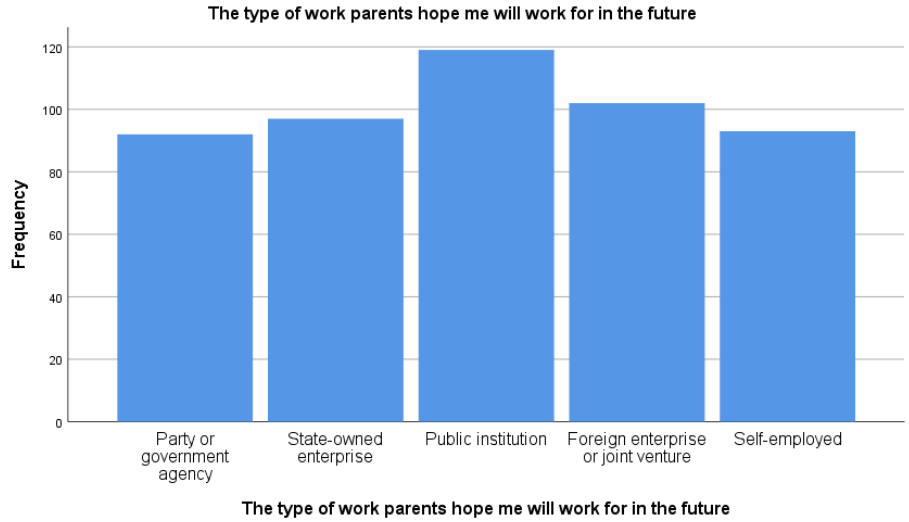


Picture 22: Distribution of respondents' expected highest level of education.

Table 32: Parental Preferences for Their Child's Future Employment Sector

The type of work parents hope their child will work for in the future					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Party or government agency	92	18.3	18.3	18.3
	State-owned enterprise	97	19.3	19.3	37.6
	Public institution	119	23.7	23.7	61.2
	Foreign enterprise or joint venture	102	20.3	20.3	81.5
	Self-employed	93	18.5	18.5	100.0
	Total	503	100.0	100.0	

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Picture 23: Distribution of respondents' preferred employment sectors

Table 33: Student Confidence Levels in the Employment Prospects of Their Major

I am confident about the employment prospects of your major					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very true	257	51.1	51.1	51.1
	Somewhat true	225	44.7	44.7	95.8
	Not true	11	2.2	2.2	98.0
	Very false	10	2.0	2.0	100.0
	Total	503	100.0	100.0	



Picture 24: Distribution of responses to a statement regarding personal experience or perception.

Appendix C: Normality and Outlier Detection Results

This appendix presents detailed results of data screening procedures, including normality tests, missing data analysis, and outlier detection.

C1. Sample Sizes and Missing Data

Table 34: Sample Sizes and Missing Data for All Study Variables

Statistics		Individual Factor of the Student	Teacher Factor	Companion Factor	School Environment Factors	Behavioral Engagement	Cognitive Engagement	Emotional Engagement	Family Environment Factors	Social Environment Factors
N	Valid	503	503	503	503	503	503	502	503	503
	Missing	0	0	0	0	0	0	1	0	0

Table 35: Case Processing Summary for All Study Variables

Case Processing Summary	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Individual factor of student	502	99.8%	1	0.2%	503	100.0%
Teacher Factor	502	99.8%	1	0.2%	503	100.0%
Companion Factor	502	99.8%	1	0.2%	503	100.0%
School Environment Factor	502	99.8%	1	0.2%	503	100.0%
Behavioral Engagement	502	99.8%	1	0.2%	503	100.0%
Cognitive Engagement	502	99.8%	1	0.2%	503	100.0%
Emotional Engagement	502	99.8%	1	0.2%	503	100.0%
Family Environment Factor	502	99.8%	1	0.2%	503	100.0%
Social Environment Factors	502	99.8%	1	0.2%	503	100.0%

Note: Missing data was minimal (<0.2%) and concentrated in a single variable (Emotional Engagement). Listwise deletion was applied, resulting in a final sample of 502 cases for multivariate analyses.

C2. Normality Tests

Table 36: Tests of Normality for All Study Variables: Kolmogorov-Smirnov and Shapiro-Wilk

Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Individual factor of student	.091	502	.000	.962	502	.000
Teacher Factor	.097	502	.000	.960	502	.000
Companion Factor	.092	502	.000	.957	502	.000
School Environment Factor	.084	502	.000	.965	502	.000
Behavioral Engagement	.101	502	.000	.959	502	.000
Cognitive Engagement	.098	502	.000	.955	502	.000
Emotional Engagement	.083	502	.000	.980	502	.000
Family Environment Factor	.217	502	.000	.819	502	.000
Social Environment Factors	.193	502	.000	.906	502	.000

a. Lilliefors Significance Correction

Note: Both Kolmogorov-Smirnov and Shapiro-Wilk tests yielded $p < 0.001$ for all variables, indicating statistically significant deviation from perfect normality. However, given the large sample size (N=502), these tests are highly sensitive and detect minor deviations that are typical of Likert-scale data. Visual inspection of histograms (presented in the main text) confirmed that the distributions were approximately normal, with only minor skewness and kurtosis that do not threaten the validity of multivariate analyses.

C3. Extreme Values (Outlier Detection)

Table 37: Extreme Values (Highest and Lowest Scores) for All Study Variables

Extreme Values

			Case Number	Value
Individual factor of student	Highest	1	5	5.00
		2	6	5.00
		3	8	5.00
		4	9	5.00
		5	10	5.00
	Lowest	1	84	1.00
		2	42	1.00
		3	351	1.43
		4	293	1.43

		5	308	1.57
		1	3	5.00
		2	5	5.00
	Highest	3	6	5.00
		4	8	5.00
		5	9	5.00
Teacher Factor		1	84	1.00
		2	42	1.00
	Lowest	3	203	1.50
		4	313	1.67
		5	162	1.67
		1	3	5.00
		2	5	5.00
	Highest	3	6	5.00
		4	8	5.00
		5	9	5.00
Companion Factor		1	84	1.00
		2	42	1.00
	Lowest	3	492	1.25
		4	290	1.25
		5	233	1.25
		1	3	5.00
		2	5	5.00
	Highest	3	6	5.00
		4	8	5.00
		5	9	5.00
School Environment Factor		1	84	1.00
		2	42	1.00
	Lowest	3	371	1.86
		4	356	1.86
		5	271	1.86
		1	3	5.00
		2	5	5.00
Behavioral Engagement	Highest	3	6	5.00
		4	8	5.00

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		5	9	5.00
		1	84	1.00
		2	42	1.00
	Lowest	3	340	1.25
		4	500	1.50
		5	339	1.50
		1	3	5.00
		2	5	5.00
	Highest	3	6	5.00
		4	8	5.00
		5	9	5.00
Cognitive Engagement		1	84	1.00
		2	42	1.00
	Lowest	3	479	1.57
		4	327	1.57
		5	382	1.71
		1	5	5.00
		2	37	5.00
	Highest	3	39	5.00
		4	57	5.00
		5	58	5.00
Emotional Engagement		1	248	2.00
		2	238	2.17
	Lowest	3	157	2.17
		4	350	2.33
		5	152	2.33
		1	4	5.00
		2	6	5.00
	Highest	3	23	5.00
		4	29	5.00
Family Environment Factor		5	30	5.00
		1	250	1.00
		2	146	1.25
	Lowest	3	9	1.25
		4	350	1.50

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		5	354	2.00
		1	5	5.00
		2	10	5.00
	Highest	3	20	5.00
		4	33	5.00
		5	55	5.00
Social Environment Factors		1	222	1.75
		2	42	1.75
	Lowest	3	205	2.00
		4	178	2.00
		5	149	2.00

a. Only a partial list of cases with the value 5.00 is shown in the table of upper extremes.
b. Only a partial list of cases with the value 1.67 is shown in the table of lower extremes.
c. Only a partial list of cases with the value 1.25 is shown in the table of lower extremes.
d. Only a partial list of cases with the value 1.86 is shown in the table of lower extremes.
e. Only a partial list of cases with the value 1.50 is shown in the table of lower extremes.
f. Only a partial list of cases with the value 1.71 is shown in the table of lower extremes.
g. Only a partial list of cases with the value 2.00 is shown in the table of lower extremes.

Note: All extreme values fall within the valid response range (1–5) of the Likert scale. No cases exhibited values outside the theoretical boundaries, indicating that outliers are natural extremes rather than data entry errors. Boxplot visual inspection (presented in the main text) confirmed the absence of problematic or influential outliers, and no cases were deleted.

Appendix D: Item-Level Descriptive Statistics and Cross-Loadings

D1. Item-Level Descriptive Statistics

Table 38:Item-Level Means and Standard Deviations for All Measurement Items

Construct	Item	Item Description (Abbreviated)	Mean	SD
Behavioral Engagement	BE1	I pay full attention and concentrate in class	3.58	1.08
	BE2	I take notes in class	3.45	1.11
	BE3	I actively participate in class discussions	3.21	1.12
	BE4	I complete coursework and assignments diligently	3.68	1.03

Cognitive Engagement	CE2	I can integrate knowledge from different courses	3.35	1.05
	CE3	I can identify valuable content from material	3.51	1.04
	CE4	I can consider issues from different perspectives	3.56	1.05
	CE5	I can use evidence to judge others' opinions	3.28	1.12
	CE6	I can reflect on and adjust my existing views	3.53	1.06
	CE7	I can reflect on strengths and weaknesses of my learning	3.53	1.09
Emotional Engagement	EE4	What I learned sparked my interest and curiosity	3.92	0.76
	EE5	I hope to master material well regardless of grades	3.77	0.81
	EE6	I hope to gain a sense of self-achievement	3.88	0.79
Individual Factor	IF1	What I learned can help me achieve better development	3.62	1.02
	IF2	I have confidence to face unknown learning challenges	3.43	1.08
	IF3	I will not give up when encountering difficulties	3.52	1.09
	IF4	I believe that hard work will pay off	3.44	1.13
	IF5	I am able to put my study plan into practice	3.37	1.12
	IF6	Average daily self-study time outside class	3.18	1.14
	IF7	Average weekly internships related to career	3.37	1.07
Teacher Factor	TF2	Teacher guides and promotes meaningful discussions	3.31	1.08
	TF3	Teachers assess daily performance and practical ability	3.49	1.08
	TF4	Teacher's timely feedback helps improve learning	3.47	1.07
	TF5	Teachers discuss career planning with me	3.51	1.06
	TF6	Teachers discuss academic issues with me	3.48	1.08
Companion Factor	CF1	I complete homework or study tasks with classmates	3.5	1.16
	CF2	I discuss learning problems with classmates	3.46	1.15

	CF3	I participate in extracurricular activities with classmates	3.49	1.18
	CF4	I receive practical study assistance from classmates	3.44	1.18
School Environment	SE2	Internship base meets needs	3.48	1.03
	SE3	Digital teaching platforms enhance learning experience	3.55	1.05
	SE4	Academic support services (guidance center, etc.)	3.49	1.03
	SE5	Financial support (scholarships, on-campus positions)	3.52	1.05
	SE6	Physical and mental health support (medical, counseling)	3.55	1.05
	SE7	Encourages participation in innovation competitions	3.56	1.04
	SE8	Emphasizes good personal qualities (honesty, charity)	3.62	1.01
	SE9	Encourages cross-cultural and cross-regional communication	3.51	1.03
	SE10	Encourages interdisciplinary communication	3.48	1.03
	SE11	Encourages diversified career paths	3.45	1.04
	SE12	Provides rich learning resources (dual degrees, exchange)	3.46	1.06
	SE13	Provides employment support (consultations, workshops)	3.45	1.04
	SE14	Students have channels to give feedback to school	3.48	1.05
Family Environment	FEF1	Highest education level of parents (combined index)	4.2	2.29
	FEF2	Parents' occupations (combined index)	3.97	1.72
	FEF3	Total household income	3.88	1.99
	FEF4	Pre-college home location and hukou status (combined)	4.09	1.5
Social Environment	SOEF 1	What I have learned will help me and my family have a better life	4.32	0.8
	SOEF 2	What I have learned can help me make better contributions to society	4.26	0.79

Note: All items measured on a 1-5 Likert scale. Higher scores indicate higher levels of the construct or more positive perceptions.

D2. Cross-Loadings Table

*Table 39:*Cross-Loadings of All Measurement Items

Item	BE	CE	CF	EE	FEF	IF	SEF	SOEF	TF
BE1	0.867	0.533	0.449	-0.062	-0.084	0.486	0.62	-0.083	0.513
BE2	0.87	0.528	0.5	-0.076	-0.069	0.478	0.689	-0.074	0.528
BE3	0.859	0.523	0.472	-0.06	-0.089	0.49	0.699	-0.072	0.52
BE4	0.862	0.474	0.459	-0.069	-0.099	0.459	0.681	-0.067	0.516
CE2	0.509	0.875	0.491	-0.036	-0.107	0.512	0.595	-0.106	0.535
CE3	0.528	0.858	0.508	-0.072	-0.098	0.537	0.595	-0.089	0.512
CE4	0.496	0.858	0.46	-0.071	-0.128	0.52	0.558	-0.094	0.53
CE5	0.466	0.856	0.457	-0.075	-0.099	0.502	0.593	-0.074	0.502
CE6	0.492	0.863	0.479	-0.058	-0.118	0.509	0.593	-0.084	0.523
CE7	0.507	0.883	0.504	-0.069	-0.099	0.523	0.618	-0.091	0.553
CF1	0.503	0.486	0.879	-0.059	-0.108	0.512	0.566	-0.06	0.775
CF2	0.455	0.514	0.868	-0.059	-0.094	0.489	0.533	-0.038	0.773
CF3	0.469	0.491	0.888	-0.049	-0.108	0.51	0.555	-0.054	0.8
CF4	0.477	0.482	0.869	-0.071	-0.1	0.487	0.568	-0.052	0.788
EE4	-0.062	-0.074	-0.076	0.909	0.755	-0.009	-0.051	0.611	-0.093
EE5	-0.078	-0.066	-0.055	0.913	0.775	-0.018	-0.066	0.62	-0.101
EE6	-0.068	-0.073	-0.056	0.877	0.726	-0.01	-0.057	0.6	-0.095
FEF1	-0.053	-0.079	-0.077	0.63	0.769	-0.019	-0.057	0.586	-0.096
FEF2	-0.084	-0.088	-0.093	0.611	0.741	-0.052	-0.067	0.57	-0.092
FEF3	-0.083	-0.091	-0.095	0.589	0.712	-0.057	-0.089	0.543	-0.093
FEF4	-0.071	-0.087	-0.075	0.561	0.569	-0.039	-0.065	0.521	-0.093
IF1	0.471	0.495	0.466	-0.012	-0.062	0.841	0.534	-0.016	0.593
IF2	0.462	0.507	0.476	-0.014	-0.057	0.85	0.537	-0.018	0.623
IF3	0.478	0.525	0.497	-0.011	-0.052	0.842	0.534	-0.024	0.617
IF4	0.469	0.516	0.487	-0.02	-0.061	0.858	0.563	-0.025	0.629
IF5	0.469	0.504	0.497	-0.008	-0.034	0.842	0.539	-0.018	0.616
IF6	0.448	0.486	0.48	-0.006	-0.043	0.845	0.555	-0.015	0.6
IF7	0.478	0.506	0.483	-0.018	-0.059	0.844	0.543	-0.022	0.619
SEF2	0.653	0.56	0.521	-0.04	-0.071	0.539	0.8	-0.059	0.562
SEF3	0.638	0.572	0.523	-0.046	-0.073	0.541	0.818	-0.065	0.576
SEF4	0.637	0.564	0.518	-0.053	-0.073	0.53	0.828	-0.053	0.566
SEF5	0.624	0.543	0.502	-0.048	-0.087	0.523	0.817	-0.059	0.547
SEF6	0.638	0.559	0.517	-0.058	-0.084	0.535	0.809	-0.061	0.564
SEF7	0.625	0.541	0.506	-0.054	-0.078	0.514	0.789	-0.067	0.543
SEF8	0.619	0.558	0.522	-0.051	-0.086	0.514	0.819	-0.06	0.554
SEF9	0.644	0.553	0.518	-0.047	-0.083	0.514	0.813	-0.062	0.557
SEF10	0.624	0.552	0.517	-0.056	-0.09	0.519	0.816	-0.062	0.556

SEF11	0.545	0.497	0.469	-0.042	-0.064	0.46	0.72	-0.049	0.487
SEF12	0.529	0.474	0.45	-0.042	-0.07	0.439	0.713	-0.05	0.475
SEF13	0.561	0.49	0.461	-0.043	-0.077	0.458	0.732	-0.056	0.497
SEF14	0.565	0.492	0.452	-0.047	-0.075	0.445	0.717	-0.057	0.492
SOEF1	-0.083	-0.101	-0.059	0.675	0.767	-0.023	-0.074	0.995	-0.072
SOEF2	-0.068	-0.079	-0.047	0.543	0.614	-0.02	-0.058	0.797	-0.056
TF2	0.426	0.422	0.652	-0.083	-0.088	0.518	0.504	-0.047	0.711
TF3	0.524	0.528	0.768	-0.091	-0.113	0.633	0.587	-0.061	0.86
TF4	0.507	0.526	0.758	-0.087	-0.114	0.624	0.577	-0.063	0.858
TF5	0.519	0.521	0.771	-0.096	-0.132	0.622	0.59	-0.065	0.857
TF6	0.509	0.524	0.773	-0.094	-0.12	0.621	0.588	-0.061	0.859

Note: Bold values indicate the highest loading for each item on its designated construct. All items load most strongly on their respective constructs, confirming discriminant validity at the item level.

Appendix E: Heterotrait-Monotrait (HTMT) Ratio

This appendix presents the full HTMT matrix used for discriminant validity assessment.

Table 40:Heterotrait-Monotrait Ratio (HTMT) for Discriminant Validity Assessment

Construct Pair	HTMT Value
Behavioral Engagement ↔ Cognitive Engagement	0.642
Behavioral Engagement ↔ Companion Factor	0.606
Behavioral Engagement ↔ Emotional Engagement	0.088
Behavioral Engagement ↔ Family Environment Factor	0.11
Behavioral Engagement ↔ Individual Factor	0.608
Behavioral Engagement ↔ School Environment Factor	0.824
Behavioral Engagement ↔ Social Environment Factor	0.193
Behavioral Engagement ↔ Teacher Factor	0.674
Cognitive Engagement ↔ Companion Factor	0.611
Cognitive Engagement ↔ Emotional Engagement	0.084
Cognitive Engagement ↔ Family Environment Factor	0.135

Cognitive Engagement ↔ Individual Factor	0.639
Cognitive Engagement ↔ School Environment Factor	0.722
Cognitive Engagement ↔ Social Environment Factor	0.328
Cognitive Engagement ↔ Teacher Factor	0.667
Companion Factor ↔ Emotional Engagement	0.077
Companion Factor ↔ Family Environment Factor	0.13
Companion Factor ↔ Individual Factor	0.621
Companion Factor ↔ School Environment Factor	0.682
Companion Factor ↔ Social Environment Factor	0.194
Companion Factor ↔ Teacher Factor	0.892
Emotional Engagement ↔ Family Environment Factor	0.734
Emotional Engagement ↔ Individual Factor	0.035
Emotional Engagement ↔ School Environment Factor	0.067
Emotional Engagement ↔ Social Environment Factor	0.466
Emotional Engagement ↔ Teacher Factor	0.12
Family Environment Factor ↔ Individual Factor	0.071
Family Environment Factor ↔ School Environment Factor	0.108
Family Environment Factor ↔ Social Environment Factor	0.614
Family Environment Factor ↔ Teacher Factor	0.155
Individual Factor ↔ School Environment Factor	0.569
Individual Factor ↔ Social Environment Factor	0.188
Individual Factor ↔ Teacher Factor	0.792
School Environment Factor ↔ Social Environment Factor	0.214

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School Environment Factor ↔ Teacher Factor	0.744
Social Environment Factor ↔ Teacher Factor	0.202

Note: HTMT values below 0.85 indicate adequate discriminant validity. All values meet this criterion except Companion Factor ↔ Teacher Factor (0.892), which slightly exceeds the conservative threshold but remains below 0.90. Given the conceptual overlap between peer interaction and teaching quality in classroom settings, this minor exceedance is theoretically justifiable and does not threaten overall discriminant validity.

Appendix F: Interview Protocol and Thematic Analysis Framework

This appendix presents the complete interview protocol, participant demographic information, thematic coding framework, and coding summary used for qualitative data analysis.

F1. Interview Protocol (Semi-Structured Interview Outline)

Table 41. Structured Interview Outline for Respondents

Serial Number	Interview Question
1	Are you satisfied with your current learning status?
2	What are your favorite learning styles or methods?
3	How do you usually participate in classroom and extracurricular learning? What methods do you usually use?
4	Are you involved in any competitions, projects, or internships? How have they impacted you?
5	How do you understand and master complex content in your studies?
6	When faced with difficulties, how do you usually deal with them? What kind of help do you actively seek?
7	Are you satisfied with your current major and courses?
8	Have you had any learning experiences that made you feel happy or a sense of belonging?
9	Have you ever felt like giving up or feeling depressed due to setbacks or pressure? What was the reason?
10	Which teacher had the greatest influence on your studies? Why?
11	Would you like to study with classmates? Why?
12	Do you think the school's learning resources (library, laboratories, internship opportunities, etc.) are sufficient?

13	Does your family support your studies or put pressure on you?
14	What impact will society's employment pressure have on your studies?
15	Are there other aspects that may affect your commitment to learning?

F2. Demographic Information of Interview Participants

Table 42:Basic Personal Information of Interview Respondents (N=20)

Respondent ID	Gender	Grade	Major Category	Class Leader Experience
S1	Male	Junior	Engineering	Yes
S2	Female	Sophomore	Liberal Arts	No
S3	Male	Freshman	Medical Sciences	Yes
S4	Female	Senior	Arts	No
S5	Male	Junior	Sciences	Yes
S6	Female	Sophomore	Engineering	Yes
S7	Male	Senior	Medical Sciences	No
S8	Female	Junior	Liberal Arts	Yes
S9	Male	Freshman	Sciences	No
S10	Female	Senior	Arts	Yes
S11	Male	Sophomore	Engineering	No
S12	Female	Junior	Medical Sciences	Yes
S13	Male	Senior	Liberal Arts	No
S14	Female	Freshman	Sciences	No
S15	Male	Junior	Arts	Yes
S16	Female	Senior	Engineering	Yes
S17	Male	Sophomore	Medical Sciences	No
S18	Female	Junior	Liberal Arts	Yes
S19	Male	Freshman	Engineering	No
S20	Female	Senior	Sciences	Yes

F3. Thematic Coding Framework

Table 43:Thematic Analysis Coding Framework

Theme	Code	Description	Representative Quotations
Behavioral Engagement	BE-Participation	Classroom attendance, participation, assignment completion	"I usually attend all classes and try to complete assignments on time." (S8)
	BE-Discipline	Self-discipline and study habits	"Sometimes I skip discussions if I feel the topic is not important." (S11)
Cognitive Engagement	CE-Deep Learning	Critical thinking, analysis, application	"If the teacher gives case studies, I try to analyze them instead of just memorizing." (S7)
	CE-Surface Learning	Memorization, rote learning	"I usually just memorize the key points because exams are based on them." (S14)
Emotional Engagement	EE-Interest	Interest and curiosity in learning	"What I learned sparked my interest and curiosity." (S2)
	EE-Motivation	Internal and external motivation	"I hope to master material well, even if it doesn't show up in my grades." (S15)
	EE-Belonging	Sense of belonging to school/class	"When the teacher encourages us, I feel more interested in the subject." (S2)
Individual Factors	IF-Motivation	Personal drive and goals	"I study hard because I want to get a good job after graduation." (S5)
	IF-Self-Efficacy	Confidence in learning ability	"When I manage my time well, I can participate more in class activities." (S9)
	IF-Time Management	Time organization and planning	"When I manage my time well, I can participate more." (S9)
Teacher Factors	TF-Teaching Quality	Instructional clarity, methods	"When teachers explain clearly and give feedback, I feel more confident." (S1)
	TF-Feedback	Timely and constructive feedback	"If the class is only lectures, I feel sleepy and not interested." (S16)
	TF-Interaction	Teacher-student interaction	"Teachers discuss career planning with me." (S10)
Peer Factors	PF-Collaboration	Group work, study groups	"Studying with friends helps me understand better." (S6)

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	PF-Distraction	Negative peer influence	"Sometimes group work is not effective because some students are not serious." (S13)
School Environment	SE-Resources	Library, labs, digital platforms	"The library and online learning system make studying easier." (S8)
	SE-Infrastructure	Physical and digital infrastructure	"Sometimes internet problems make online learning difficult." (S17)
Family Environment	FE-Support	Parental encouragement and support	"My parents always encourage me to study hard." (S10)
	FE-Pressure	Parental expectations and pressure	"My family expects me to get a good job, so I have to study seriously." (S12)
Social Environment	SO-Employment	Job market competition, career pressure	"Because of job competition, I try to improve my skills." (S4)
	SO-Uncertainty	Job market uncertainty	"Sometimes I feel confused because job opportunities are not stable." (S19)

F4. Coding Summary Table

Table 44:Frequency of Theme References Across Interviews

Theme	Number of Respondents Referencing	Total References
Family Support (FE-Support)	18	42
Teaching Quality (TF-Teaching Quality)	16	35
Peer Collaboration (PF-Collaboration)	15	28
Employment Pressure (SO-Employment)	14	25
Self-Motivation (IF-Motivation)	13	22
School Resources (SE-Resources)	12	20
Interest in Learning (EE-Interest)	11	18
Time Management (IF-Time Management)	9	14

Teacher Feedback (TF-Feedback)	8	12
Belonging (EE-Belonging)	7	10
Peer Distraction (PF-Distraction)	6	9
Infrastructure Issues (SE-Infrastructure)	5	7
Employment Uncertainty (SO-Uncertainty)	4	6

Note: Total references count the number of times each theme was mentioned across all interviews. Family support, teaching quality, and peer collaboration were the most frequently discussed themes, consistent with the quantitative findings.

Appendix G: Model Fit and Quality Criteria

This appendix presents additional model quality criteria for the PLS-SEM analysis, including model fit indices, predictive relevance (Q^2), effect sizes (f^2), and the full correlation matrix of all constructs.

G1. Model Fit Indices

Table 45:Model Fit Indices for the Structural Model

Fit Index	Value	Recommended Threshold
SRMR (Standardized Root Mean Square Residual)	0.068	< 0.08 (acceptable), < 0.06 (good)
d_ULS (Squared Euclidean Distance)	2.847	-
d_G (Geodesic Distance)	1.326	-
Chi-Square	1,845.67	-
NFI (Normed Fit Index)	0.782	> 0.80 (acceptable)

Note: The SRMR value of 0.068 is below the acceptable threshold of 0.08, indicating a good model fit. The NFI value of 0.782 is slightly below 0.80 but is considered acceptable for complex models with many indicators, as in this study.

G2. Predictive Relevance (Q^2) and Effect Sizes (f^2)

*Table 46:*Predictive Relevance (Q^2) and Effect Sizes (f^2)

Endogenous Construct	R^2	Q^2	Predictor Construct	f^2 (Effect Size)
Behavioral Engagement	0.613	0.448	Individual Factor	0.049 (Small)
			Teacher Factor	0.028 (Small)
			Companion Factor	0.099 (Medium)
			School Environment Factor	0.403 (Large)
			Family Environment Factor	0.020 (Small)
			Social Environment Factor	0.010 (Small)
Cognitive Engagement	0.525	0.387	Individual Factor	0.136 (Medium)
			Teacher Factor	0.494 (Large)
			Companion Factor	0.058 (Small)
			School Environment Factor	0.115 (Medium)
			Family Environment Factor	0.347 (Medium-Large)
			Social Environment Factor	0.017 (Small)
Emotional Engagement	0.702	0.559	Individual Factor	0.091 (Medium)
			Teacher Factor	0.000 (No effect)
			Companion Factor	0.007 (No effect)

School Environment Factor	0.011 (Small)
Family Environment Factor	0.205 (Medium-Large)
Social Environment Factor	0.033 (Small)

Note: Q^2 values > 0 indicate predictive relevance. f^2 effect size interpretation: 0.02 = small, 0.15 = medium, 0.35 = large (Cohen, 1988).

G3. Correlation Matrix of All Constructs

Table 47:Pearson Correlations Among All Constructs (N=502)

	BE	CE	CF	EE	FEF	IF	SEF	SOEF	TF
BE	1								
CE	0.585**	1							
CF	0.543**	0.560**	1						
EE	-0.078	-0.078	-0.07	1					
FEF	-0.099*	-0.125**	-0.118**	0.835**	1				
IF	0.554**	0.598**	0.570**	-0.015	-0.062	1			
SEF	0.777**	0.682**	0.633**	-0.063	-0.100*	0.641**	1		
SOEF	-0.084	-0.101*	-0.059	0.678**	0.770**	-0.024	-0.074	1	
TF	0.600**	0.608**	0.892**	-0.106*	-0.138**	0.725**	0.686**	-0.072	1

Note: $p < 0.01$, $p < 0.05$. BE = Behavioral Engagement, CE = Cognitive Engagement, CF = Companion Factor, EE = Emotional Engagement, FEF = Family Environment Factor, IF = Individual Factor, SEF = School Environment Factor, SOEF = Social Environment Factor, TF = Teacher Factor.

G4. Outer Variance Inflation Factor (VIF) Values

Table 48: Outer VIF Values for All Measurement Items

Item	VIF	Item	VIF	Item	VIF
BE1	2.366	CE7	3.23	SE10	3.159
BE2	2.411	CF1	2.509	SE11	2.618
BE3	2.249	CF2	2.413	SE12	2.523

BE4	2.249	CF3	2.662	SE13	2.861
CE2	3.056	CF4	2.474	SE14	2.389
CE3	2.799	EE4	3.102	SE2	2.742
CE4	2.728	EE5	3.163	SE3	3.072
CE5	2.731	EE6	1.983	SE4	3.203
CE6	2.843	FEF1	2.083	SE5	3.122
IF1	2.613	FEF2	2.462	SE6	2.975
IF2	2.713	FEF3	2.866	SE7	2.955
IF3	2.61	FEF4	2.431	SE8	3.168
IF4	2.887	SOEF1	1.006	SE9	3.344
IF5	2.591	SOEF2	1.006	TF2	1.425
IF6	2.613	TF3	2.629	TF4	2.605
IF7	2.569	TF5	2.549	TF6	2.651

Note: All VIF values are well below the conservative threshold of 3.3 and far below the critical threshold of 5.0, indicating no significant multicollinearity issues at the indicator level.

G5. Inner Variance Inflation Factor (VIF) Values

Table 49: Inner VIF Values for Predictor Constructs

Predictor Construct	Behavioral Engagement	Cognitive Engagement	Emotional Engagement
Individual Factor	2.5	2.5	1.839
Teacher Factor	3.621	3.621	-
Companion Factor	2.341	2.341	1.822
School Environment Factor	2.108	2.108	2.077
Family Environment Factor	2.501	2.501	2.487
Social Environment Factor	2.467	2.467	2.466

Note: All inner VIF values are well below the critical threshold of 5.0 and mostly below the conservative threshold of 3.3, confirming that multicollinearity does not threaten the stability of parameter estimates in the structural model.