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Engineering Undergraduates' Academic Dishonesty: An Empirical Study in China*

LIU XIN JUAN[1,2] and ZHANG BIN[1]
[1] Baoji University of Arts and Sciences, No. 1 Hi-Tech Avenue, Baoji, Shaanxi, P. R. China, 721013.
E-mail: liuxj0905@163.com, bjwlxyzb@163.com
[2] SEGi University, Faculty of Education, Languages & Psychology, No 9, Jalan Teknologi, Kota Damansara, 47810, Petaling Jaya, Selangor, Malaysia.

Academic dishonesty (AD) in higher education institutions worldwide has become a significant concern. However, there are few related empirical and theoretical studies on schoolwork among engineering students. This study aimed to investigate the prevalence of academic dishonesty behaviors and the effectiveness of the extended Theory of Planned Behavior (TPB) in forecasting AD behaviors among Chinese engineering undergraduates at four public universities in China. This study employed a quantitative method and collected 474 responses via an online questionnaire among engineering undergraduates from four selected public universities in China. The results demonstrated that the participation rate of AD behaviors among engineering undergraduates at these four public universities is not very high. In the extended model, four predictive variables – attitude, control, norms, and justification are statistically efficient in predicting intention, which accounted for 65.6% of the variance. Meanwhile, intention, attitude, and norms together predicted 22.9% of the variance of behaviors. Attitude, norms, control, and justifications can influence AD behavior directly and indirectly through intentions. Targeted measures to decrease or deter intentions and behaviors of academic dishonesty are conducive to the sustainable development of integrity education.

Keywords: extended TPB; academic dishonesty behaviors; Chinese engineering undergraduates; education for sustainability

1. Introduction

Over the past three decades, academic dishonesty (AD) among students in higher education institutions has become a significant concern [1–6]. International Center for Academic Integrity (ICAC) classified cheating, plagiarism, lying, and deception under the umbrella of AD and has revealed that more than 60% of students have admitted to cheating in some way during their academic studies over the past decades (2022). AD also was a serious problem for Chinese students [1, 2] and was not friendly to the Sustainable Development of Education (SDE). Unfortunately, fewer theoretical and empirical studies have been carried out in mainland China to examine AD frequency and antecedents affecting students' AD, there were only a few publications to review and reference [4, 7].

Previous studies showed that the proportion of undergraduate students who report engaging in different kinds of AD varies by discipline, which was higher for vocationally oriented majors, and Engineering is one of them. The majority of studies concluded that business students have the highest cheating rate [8, 9] or more than engineering students [10, 11]. However, [12] revealed that business students claimed to engage in less online dishonesty compared to engineering students. It suggests that engineering students' AD behavior remains an issue of concern since they play a key role in engineering technological innovation and industrial creativity.

The widespread use of computer and internet technology has significantly transformed teaching and learning styles. Student learning seems to have become easier and more convenient online, and many previous studies suggested that internet sources facilitated and increased academic misconduct since technology has increased learners' access to online knowledge resources [13–15]. Engineering graduates are future engineers, and their ethical awareness plays a crucial role in the development of society. As stated by [16], important ethical issues were constantly emerging, and some innovative technologies were violating people's privacy daily.

Coupled with the global spread of the covid-19 virus led to a greater reliance on smart application media for teaching and learning. Chinese undergraduates have gone through long-time online learning and examination experiences. Though a recent study revealed that compared to face-to-face teaching, the remote teaching methods did not have the necessary effect levels of stress for students [17]. Many engineering faculties in the United States still eliminated course assignments to accommodate changes during the epidemic [18]. However, Chinese engineering undergraduates have higher academic loads and face more employment pressure after the epidemic outbreak. In addition to regular assignments and exams, various experiments and

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course design reports account for a large proportion of their academic score. [19] presented evidence of widespread online cheating among students under covid-19 lockdowns with no proctoring. It could be stated that academic integrity violations have increased directly owing to online learning implemented as a result of the epidemic in the recent three years. This is a challenge for engineering students who are good at using science and technology.

While concerns regarding academic integrity have emerged on a global scale, research has not yet thoroughly addressed the issue of academic dishonesty among Chinese engineering students or the factors that contribute to such behaviors [20]. Especially on the basis of a mature theoretical framework, it was limited in the Chinese context. How Chinese university engineering students fare on these scales has not been understood or investigated. There is thus a gap in understanding how these factors influence engineering students' AD behavior, and it needs to be investigated.

It is significant to develop a comprehensive model to understand dishonesty among engineering students utilizing the TPB [21], which showed that students' intentions to involve in dishonesty were influenced by their attitudes toward behavior, perceptions of the social norms regarding the behavior, and their judgments of ability to engage in the behavior.

Adding predictor contributes to explaining engineering undergraduates' intentions and AD behaviors and also benefit international engineering students' integrity education.

The research questions are:

(1) What is the level of AD behavior of the engineering undergraduates in the four selected universities?
(2) What factors influence these engineering undergraduates' behaviors of academic dishonesty?

The applications of TPB to behavior studies were quite extensive and effective in Western countries [5, 22–26], but there were very limited applications to the academic integrity of Chinese engineering undergraduates. This research will overcome this gap and verify the effectiveness of the extended TPB in predicting AD behaviors among engineering undergraduates on campus. Therefore, the following are the study's specific objectives:

(a) Investigate the prevalence rate of AD behaviors among engineering undergraduates in these four selected universities.
(b) Examine the factors that influence engineering undergraduates' AD behaviors based on the extended TPB model.
(c) Evaluate the effectiveness of the extended TPB model fit to explain AD behaviors.

This study contributes to determining the effective means of curbing such behaviors to help universities, colleges, faculty members, and students in upholding academic integrity and promote the sustainable development of honest education.

2. Literature Review

2.1 AD Behavior

AD was defined as any inappropriate behaviors/actions that occur in the academic exercise processes [27]. [28] highlighted that AD was dishonest behavior at school in order to result in a positive grade. [29] defined AD as the expectation of students who are expected to produce independent academic work and must appropriately acknowledge any outside sources of information mentioned in their work. [30] further defined AD as cheating, fabrication of information or citations, the assistance of others' academic dishonest behaviors, and using someone else's words, ideas, or statements as their own are prohibited. Generally speaking, the definition of AD is not uniform, which is influenced by way of the learning and assessment procedures culture across countries. In this study, the actual situations of Chinese engineering undergraduates' academic works include exams, tests, academic projects, course assignments, experiment reports, and theses.

Consequently, this study assesses engineering undergraduates' AD behaviors via three scenarios: examinations (tests), assignments, and plagiarism. According to the researchers' knowledge, based on the few empirical studies that investigate AD among university students in the context of China, the assessment of AD behavior was usually only for cheating during examination [6–8, 31] or paper plagiarism [32, 33], and few studies have included both or more of other generally AD behaviors. Most important was that the three types were the criteria for assessing engineering undergraduates' academic performance. Above all, cheating on examinations or tests, cheating on an assignment, and plagiarism are the three most recognized assessment methods in the literature review and are also suitable for evaluating academic dishonesty of Chinese engineering undergraduates.

Of the few surveys of academic integrity among engineering students, different levels of AD behavior participation were reported. [34] found that more than 96% of engineering students reported participating in at least one AD behavior; [35]

mentioned that engineering students reported higher levels of cheating at 82% compared with 73% for students in social sciences subjects. In addition, except for business majors [10], engineering students reported more self-report cheating [9] than any other majors. However, these surveys are relatively early and are being conducted in the United States context, and the level of participation of Chinese engineering students is still awaiting investigation.

2.2 Ajzen's Theory of Planned Behavior (TPB)

TPB predicts actual behaviors by predicting persons' intent to engage in activities at a particular time and place, which seems to be one of the most popular and influential basic psychological theories/ frameworks to explain and predict a wide range of dishonest behaviors among students. The perceptions of three constructs influence a people's intention: attitude toward behavior, subjective norm (SN), and perceived behavioral control (PBC).

Attitude toward academic dishonesty was defined as a certain mood in which one responds positively or negatively to an object, person, institution, or event [21]. Thus, attitude belief was a positive or negative reaction, cognition of ethical or not, favorably or unfavorably evaluation, level of approval or disapproval, good or bad feelings would be for a group of specific AD behaviors. The majority of studies supported that attitudes toward AD had a significant correlation with the intention to commit AD [26, 36–42] and AD behavior [25, 43]. It meant that students' attitudes toward AD would significantly affect their dishonesty intention and behavior.

Subjective norm was defined as *individuals' perceptions that most people are important and they should or should not perform the behavior* [21, 44]. Norm beliefs focus on the individuals' surroundings (comprises a social network and cultural norms, like the observed prevalence of peers' dishonesty) and the normative expectations of those people who are important to the individuals (such as their family members, siblings, friends, teachers, etc.) in terms of behavior. Previous studies confirmed significant relationships between SN and intention [23, 36, 38, 42, 45] and AD behavior [46]. It indicated that peers and others normative expectations of dishonesty could directly affect students' intentions and behavior regarding AD.

Perceived behavioral control refers to *people perceived ease or difficulty in performing the behavior of interest based on past experiences and anticipated impediments* [21]. PBC measured the level of easiness to enact AD behaviors (e.g., it's easy to cheat on exams) [27, 47], constraints and pressures to perform or refrain from performing non-prohibited behaviors, as well as the belief that they can cheat [22]. Several studies [5, 25, 26, 36–40, 48, 49] have empirically supported that PBC significantly impacts the intention and behavior to commit AD. The more difficult students feel or perceive in succeeding with AD behavior, the less likely they are intended and engaged in AD behavior.

Intention to academic dishonesty [50] argued that intentions were *how committed a person was to perform a given behavior*. Intentions test the likelihood of students participating in the given AD behavior. The positive correlation between intention and actual AD behaviors is so strong that no related study has been found failing to support a significant relationship between the two. That is, the likelihood of students performing dishonest activity increases with the strength of their intention to do so.

Justification for academic dishonesty [23] first added the justifications to constitute a new modification of TPB. In their opinion, justification was students would rationalize their dishonesty as being acceptable. The evaluation of the justifications scale measured the possibility of students justifying their AD behaviors. For example, helping friends, achieving better grades, perceived peers cheating, pressure from family, monetary reward, etc. In earlier studies, justification was found to play a variety of roles: it mediated the predictors and behavior [23, 51] or predictors and intention [41]; a recent study found it significantly moderated the PBC-intention relationship [26]. Moreover, it was significantly related to intention [26, 51] and behavior [23]. Justification is included in this study to reduce the cognitive dissonance that engineering students may feel due to this behavior and to increase the variance in AD behavior.

2.3 Practical Applications of (revised) TPB in Predicting Academic Dishonesty Behavior

The model of TPB, developed by Icek Ajzen [44], is a full-fledged model that has been used in numerous social and natural disciplines and various places to predict various behaviors. It covers healthy living, couponing, drunkenness, fast food consumption, purchasing organic food, quitting smoking, using technology, etc.

TPB also was one of the most popular and influential basic psychological theories/frameworks to explain and predict a wide range of dishonesty in academics amongst students [5, 15, 25, 26, 40, 48, 52–54]. Nevertheless, its application and utilization in predicting and explaining the behavior of AD has been less studied. The majority of the studies found in the literature search were conducted in the United States, with only a few conducted in China

[6, 55, 56], which has remained room for implementation in China. Among these few studies, [55] discovered that attitudes, moral obligation, and PBC were positively correlated with the intention to cheat, but SN was not only a predictor of cheating but also moderated the relationship between intention and cheating. [56] claimed that PBC directly affected cheating behavior, but it did not through the medium of intention. The research of [6] revealed that the main predictors were attitude and integrity involvement, whereas SN accounted for marginal behavior variations. However, these studies were based on business and junior school students, and there was no evidence of engineering students.

The related studies always mix several disciplines together [25–27], except for [10], which were carried out in the United States, and found that attitude and the other seven predictors together significantly explain 36% of the variance in exams cheating and 14% in homework cheating. [26] used the TPB predictors plus justification, explaining 66.2% of the variance in cheating intentions. [25] showed the three TPB predictors and lack of self-control explained 24% of the variance in cheating behavior. [27] showed the three TPB predictors explained 33% of the variance in cheating behavior and explained 37.2% when adding justification and conscientiousness. Furthermore, [51] made use of the four predictors and justification to predict 23.5% and 50.7% of the variance of misconduct intentions, respectively. Therefore, we include justification as a modifying predictor to organize the framework to enhance the theory's predictive capabilities in China.

2.4 Hypotheses Development

According to [44], the main advantage of TPB was that variables could be added to the model to increase its explanatory power. In view of the initial stage of empirical and theoretical research on AD behavior in the Chinese context, it is crucial to rely on the TPB theoretical model to verify hypothetical relationships between constructs and to provide a basis for the subsequent use of qualitative research methods. The hypotheses developed in this study give the framework to investigate the relationships among the predictive factors, intentions, and AD behaviors. As [57] declared that testing a hypothesis and reaching a conclusion to either reject or not reject the null hypothesis is essential in quantitative research.

The majority of empirical research on AD has been performed in developed nations rather than developing nations [58]. The present empirical study overcomes the gap and, based on the TPB, proposes the hypothetical relationships and examines the effectiveness of the extended TPB in predicting AD behavior among engineering undergraduates in the four selected public universities in China. The conceptual framework included five main TPB components and justification. The hypotheses were underneath the conceptual framework, as shown in Fig. 1.

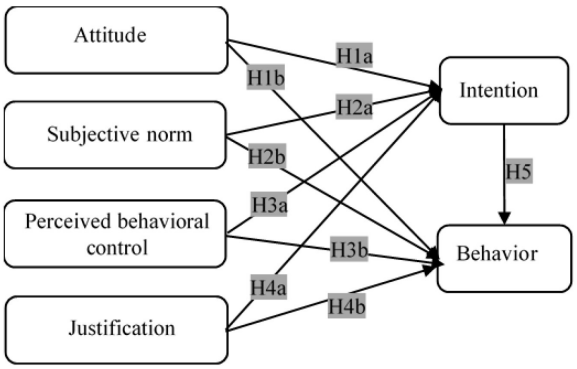

Fig. 1. Conceptual Framework of this Study.

H1a: Attitude has a significant effect on intention.
H1b: Attitude has a significant effect on behavior.
H2a: Subjective norm has a significant effect on intention.
H2b: Subjective norm has a significant effect on behavior.
H3a: Perceived behavioral control has a significant effect on intention.
H3b: Perceived behavioral control has a significant effect on behavior.
H4a: Justification has a significant effect on intention.
H4b: Justification has a significant effect on behavior.
H5: Intention has a significant effect on behavior.

3. Method

3.1 Research Design

This empirical study uses a postpositivist lens and seeks to investigate the prevalence and influencing factors of AD behavior, which adopts the quantitative research method since it examines the conceptual framework and developed hypotheses on the extended TPB. The cross-sectional survey approach is utilized to gather study data by employing a research questionnaire to satisfy the three research objectives.

3.2 Population and Sample

This study's subjects are engineering undergraduates from four Chinese public universities, and the population totaled more than forty thousand. We employed the simple random sampling technique to

Table 1. Demographic Characteristics of Respondents (N = 474)

Characteristic		M	Percent %
Gender	Male	217	45.8
	Female	257	54.2
Age	18–19	130	27.4
	20–21	130	48.5
	22–23	100	21.1
	≥24	14	3.0
Academic year	Second year	163	34.4
	Third year	189	39.9
	Fourth year	122	25.7

collect data in the four public universities in Hebei, Shandong, Gansu and Shaanxi provinces according to the students' subjects. The rationale for selecting the four provinces is that they are located in different regions of China, from economically developed North China and East China to the less developed Northwest provinces, which could minimize any potential effects of regional differences in higher education development.

This study was administered via an electronic survey using SO JUMP survey software in the fall semester of 2020. Students who completed the survey implied consent to participate. This sample did not include freshmen as respondents that were requested to provide information based on the experience of the last academic year. A total of 540 engineering undergraduates participated in this dishonest academic survey, and these respondents were primarily from the engineering fields of civil, mechanical, environmental, and electrical engineering.

In the sample, there are 45.8% male students, and 54.2% female students. The respondents are generally between 18 and 23 years old. The academic year of students who have completed the questionnaire is evenly distributed and does not include freshmen. Therefore, the distribution and structure of the sample data were good, which could continue to evaluate the reliability and validity of the research instrument.

3.3 Measures

This study aimed to identify engineering undergraduates' significant influence on AD using the TPB as the theoretical framework. The questionnaire collected analytical data with 53 close-ended questions. The first three questions asked the respondents about demographic characteristics, which consisted of gender, age, and academic year. The remaining 50 items measured in six constructs in this study are adapted from items published in the literature [23, 59–61]. (1) Attitude toward behavior consisted of 6 items, with responses ranging from 1 (strongly agree) to 5 (strongly disagree). High scores indicate an accepting and positive attitude towards AD and vice versa; (2) Perceived behavioral control consisted of 4 items, with responses ranging from 1 (strongly disagree) to 5 (strongly agree). A high score suggests that respondents believe it is easy to engage in AD behavior successfully and vice versa; (3) Subjective norm consisted of 5 items, with responses ranging from 1 (never) to 5 (always). A high score suggests a perception that others in their university engaging in AD is common and vice versa; (4) Justification and (5) Intention consisted of 9 items, with responses ranging from 1 (very unlikely) to 5 (very likely), respectively. Higher justification scores suggest that students are more prone to use a variety of circumstances to justify their consideration of AD. Higher intention scores mean a stronger willingness to participate in AD behaviors and vice versa; and (6) AD Behavior consisted of 17 items that ranged from 1 (never) to 5 (always) in cheating in exams, assignments, and plagiarism. Higher scores suggest greater levels of engagement in AD Behaviors. In this study, attitudes, SN, and PBC are exogenous variables, intention and AD behavior are endogenous variables.

4. Data Analysis

The structural equation modeling (SEM) technique was used to validate the model and examine the relationships. Conducting [62] two-step SEM approach by AMOS 24.0 software: the evaluation of the Measurement Model (confirmatory factor analysis, CFA) comes first, followed by the assessment of the Structural Model (path analysis).

4.1 Data Screening

Data screening was a crucial step to clean out some duplicate or unreasonable data to obtain good data to guarantee the authenticity and accuracy of the results. The data were screened after the respondents had answered the questionnaire. In duplicate cases, missing data, and outliers, 66 samples were cleaned, and 474 valid samples were used for validation analysis. After testing the normal distribution and multicollinearity of the six constructs, the result indicated that these constructs meet the normal variable distribution and have no problem with multicollinearity among them.

4.2 The prevalence of AD behaviors

The respondents (N = 474) were asked if they had been involved in AD behaviors to evaluate the frequency in their past academic year. Table 2 shows the percentage of engineering undergraduates admitted to three types of AD behaviors in exams, assignments, and plagiarism.

From the above data, the proportion of engineer-

Table 2. Percentage of Engineering Students Admitted to Three Types of AD Behaviors

Behaviors	Never	Seldom	Sometimes	Often	Always
Exams					
Learning content on a test from someone who has already taken it.	64.3%	20.5%	12.0%	3.0%	0.2%
Copying from another student on a test/exam without their knowledge.	79.3%	11.0%	8.6%	1.1%	0%
Helping someone else cheat on tests/exams.	69.6%	18.6%	9.3%	2.1%	0.4%
Using false excuses to delay taking tests.	86.5%	5.5%	5.7%	1.9%	0.4%
Copying from another student on a test/exam with their knowledge.	72.2%	19.4%	6.3%	1.9%	0.2%
Using unauthorized cheat notes during tests/exams.	77.4%	15.2%	5.3%	1.9%	0.2%
Using an electronic/digital device as an unauthorized aid during tests/exams.	83.1%	8.9%	5.5%	1.9%	0.6%
Assignments					
Paraphrasing/copying a few sentences from an Internet source without acknowledging it.	49.8%	28.9%	16.9%	3.8%	0.6%
Receiving unauthorized help from someone on an assignment.	61.2%	24.9%	12.0%	1.7%	0.2%
Copying another student's work and submitting it as your own.	68.1%	19.6%	10.1%	2.1%	0.1%
Submit an assignment done by someone else as your own.	82.7%	8.6%	7.2%	1.1%	0.4%
Copying material almost word for word from a written source without citing the source.	64.8%	23.0%	10.8%	1.0%	0.4%
Working with others on assignments when it is required to be done as individual assignments.	59.3%	25.1%	12.2%	3.0%	0.4%
Plagiarism					
Fabricate (make-up) references/bibliography on a project/ course exercise.	80.6%	11.2%	6.8%	1.4%	0%
Copy (cut & paste) materials (Internet, books, journal articles) for your assignments without acknowledging the sources.	69.8%	19.2%	9.7%	1.3%	0%
Paraphrase (reword) materials (Internet, books, journal articles) for your assignments without acknowledging the sources.	69.0%	20.3%	8.8%	1.5%	0.4%
How frequently do you think such cheating occurs at your university?	59.5%	25.0%	12.4%	2.5%	0.6%

ing students from the four selected universities involved in AD behaviors was between 13.5% and 50.2%. Specifically, 64.3% to 86.5% of the students reported never cheating in exams, 17.3% to 50.2% have cheated at least once in assignments, and 59.5% to 80.6% reported that they or peers had never plagiarised. The highest behavior participation rate was paraphrasing/ copying a few sentences from Internet sources without acknowledging it, and the lowest participation rate was using false excuses to delay taking a test.

4.3 Measurement Equations

CFA for the six constructs was the first step for the measurement model. The result is shown in Table 3.

Internal consistency reliability is assessed using a statistical technique, such as CR and Cronbach's alpha are calculated to examine the reliability of the questionnaire. In this study, Cronbach's alpha showed strong internal reliability (α = 0.847–0.956). Besides, the advised threshold value for CR is 0.70 [63], and the composite reliabilities in this study (ranging from 0.857 to 0.957) all exceed the acceptable value of 0.70, which revealed good internal consistency. Besides, this study regarded standardized factor loadings exceeding 0.6 as good except for ATT_1, ATT_2, SN_5 and BE_1, which were also accepted. SMC was the square of standardized factor loadings, except for four items. The remaining have SMC above 0.36, indicating sufficient item reliability.

AVE values were calculated for all constructs ranging between 0.524 and 0.711, which exceeded the 0.50 recommended cut-off value [64], indicating that convergent validity was achieved. According to the [64] criterion, discriminant validity was assessed with the squared root of the AVE value for a construct that should be greater than the correlations between latent constructs to identify probable overlaps.

As demonstrated in Table 4, it illustrated strong evidence of discriminant validity [63]. Besides, to evaluate the correlations between the variables, Pearson product-moment correlation was used, which showed that the correlation of the six constructs is significant at the 0.05 level.

Table 3. Factor loadings, Composite Reliability, and Average Variance Extracted for six Constructs

		Parameter significance estimation				Convergent validity				
Constructs	**Item**	**Unstd.**	**S.E.**	**t-value**	**P**	**Std.**	**SMC**	**CR**	**AVE**	**Alpha**
Attitude	ATT_1	1				0.551	0.304	0.865	0.524	0.861
	ATT_2	1.027	0.102	10.032	***	0.591	0.349			
	ATT_3	1.127	0.104	10.795	***	0.661	0.437			
	ATT_4	1.327	0.112	11.872	***	0.778	0.606			
	ATT_5	1.326	0.106	12.490	***	0.865	0.749			
	ATT_6	1.230	0.100	12.318	***	0.838	0.702			
PBC	PBC_1	1.000				0.797	0.635	0.904	0.708	0.896
	PBC_2	1.158	0.045	25.503	***	0.962	0.925			
	PBC_3	1.126	0.045	25.006	***	0.941	0.886			
	PBC_4	0.815	0.057	14.428	***	0.621	0.386			
SN	SN_1	1.000				0.749	0.561	0.857	0.552	0.847
	SN_2	0.958	0.056	17.153	***	0.812	0.659			
	SN_3	0.887	0.055	15.976	***	0.756	0.571			
	SN_4	0.956	0.054	17.768	***	0.845	0.714			
	SN_5	0.660	0.063	10.511	***	0.506	0.256			
Intention	INT_1	1.000				0.752	0.566	0.946	0.664	0.944
	INT_2	0.914	0.066	13.824	***	0.622	0.386			
	INT_3	1.091	0.056	19.329	***	0.836	0.698			
	INT_4	1.099	0.063	17.430	***	0.765	0.585			
	INT_5	1.169	0.056	20.801	***	0.889	0.790			
	INT_6	1.160	0.055	20.977	***	0.895	0.801			
	INT_7	1.167	0.056	20.738	***	0.886	0.786			
	INT_8	1.090	0.057	19.208	***	0.831	0.691			
	INT_9	1.049	0.055	18.967	***	0.822	0.676			
Justification	JUS_1	1.000				0.696	0.485	0.957	0.711	0.956
	JUS_2	1.213	0.070	17.320	***	0.832	0.692			
	JUS_3	1.261	0.071	17.786	***	0.856	0.732			
	JUS_4	1.247	0.067	18.522	***	0.893	0.798			
	JUS_5	1.247	0.066	18.762	***	0.905	0.820			
	JUS_6	1.240	0.069	18.015	***	0.867	0.752			
	JUS_7	1.143	0.06	17.350	***	0.834	0.695			
	JUS_8	1.355	0.077	17.653	***	0.849	0.721			
	JUS_9	1.184	0.068	17.519	***	0.842	0.709			
Behavior-Exam	BE_1	1.000				0.575	0.331	0.914	0.607	0.908
	BE_2	1.077	0.085	12.626	***	0.766	0.587			
	BE_3	1.126	0.095	11.800	***	0.689	0.475			
	BE_4	1.226	0.091	13.528	***	0.862	0.744			
	BE_5	1.220	0.093	13.176	***	0.823	0.677			
	BE_6	1.236	0.091	13.574	***	0.868	0.753			
	BE_7	1.222	0.093	13.195	***	0.825	0.680			
Behavior-Assignment	BA_8	1.000				0.739	0.545	0.917	0.648	0.914
	BA_9	1.006	0.053	18.800	***	0.858	0.736			
	BA_10	0.964	0.052	18.572	***	0.848	0.720			
	BA_11	0.774	0.047	16.631	***	0.765	0.586			
	BA_12	0.915	0.052	17.554	***	0.805	0.648			
	BA_13	1.019	0.058	17.632	***	0.808	0.653			
Behavior-Plagiarism	BP_14	1.000				0.681	0.464	0.879	0.650	0.871
	BP_15	1.501	0.085	17.749	***	0.935	0.875			
	BP_16	1.511	0.086	17.479	***	0.900	0.810			
	BP_17	1.273	0.094	13.545	***	0.672	0.452			

Note: Unstd. = Unstandardized factor loadings; Std. =Standardized factor loadings; SMC= Square Multiple Correlations; CR = Composite reliability; AVE = Average variance extracted.

Table 4. Comparison of (square-rooted) Average Variance Extracted and Correlations

Constructs	Mean	SD	Attitude	PBControl	SNorm	Intention	Justification	Behavior
Attitude	2.044	0.781	**0.724**					
PBControl	2.284	0.996	0.188**	**0.841**				
SNorm	2.376	0.793	0.093*	0.212**	**0.743**			
Intention	1.996	0.788	0.306**	0.469**	0.564**	**0.815**		
Justification	2.157	0.845	0.303**	0.428**	0.557**	0.774**	**0.843**	
Behavior	1.442	0.568	0.278**	0.225**	0.335**	0.438**	0.381**	**0.794**

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

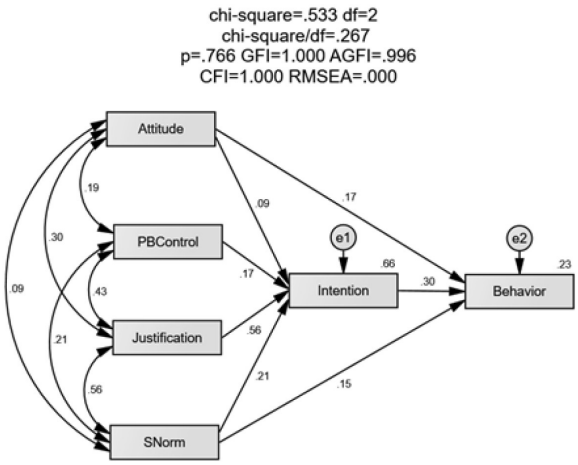

Fig. 2. The Adjusted Model with standardized Path Effects.

After validating the construct measures in the current data set, the hypothetical model was tested using the path analysis method of structural equation modeling.

Prior to this, several indices were evaluated to test the hypothetical model fitness, which included both absolute fitness indices *p*, $\chi 2$ /df (Chi-square to its degree of freedom), Root Mean Square Error of Approximation (RMSEA), incremental fit indices Adjusted Goodness of Fit Index (AGFI), Goodness of Fit Index (GFI), and Comparative Fit Index (CFI).

The hypothetical model's goodness of fit statistic revealed an unsatisfactory fit. Therefore, the model was adjusted following Modification Indices (MI), deleting the direct paths from perceived behavioral control and justification to behavior that failed to converge. Fig. 2 displays the adjusted model's goodness of fit statistics.

In the adjusted model, the absolute goodness-of-fit indices, including the $\chi 2$ /df, were equal to 0.267, less than the suggested maximum of 3. In addition, the RMSEA was 0.000, SRMR was 0.005, AGFI and GFI were 0.996 and 1.000, respectively, showing a good fit. The incremental model fit index (CFI) was above the cut-off value of a perfect fit (i.e., 0.95). Both absolute and incremental goodness-of-fit indices indicate a good fit for the adjusted model.

4.4 Structural Equations

It was crucial to the path effects of all tested constructs included in the adjusted model, which were statistically significant, logically, and practically meaningful. It indicated that high predictive values for AD behavior were found for the four predictors among engineering undergraduates in the selected universities.

In this research, it was found that attitude (β = 0.09, p < 0.01), PBC (β = 0.17, p < 0.001), justification (β = 0.56, p < 0.001), and SN (β = 0.21, p < 0.001) were all significantly related to intention and collectively predicted 65.6% of the variance. Simultaneously, attitude (β = 0.17, p<0.001), SN (β = 0.15, p < 0.01), and intention (β = 0.30, p < 0.001)

Table 5. Standardized Regression Weights

			Estimate	S.E.	t-value	P	Result
Intention	<---	Attitude	0.085	0.029	2.985	0.003	H1a support
Intention	<---	PBControl	0.169	0.024	5.642	***	H2a support
Intention	<---	SNorm	0.209	0.032	6.414	***	H3a support
Intention	<---	Justification	0.560	0.034	15.385	***	H4a support
Behavior	<---	Attitude	0.168	0.031	3.912	***	H1b support
Behavior	<---	PBControl	0.024	0.026	0.513	0.608	H2b reject
Behavior	<---	SNorm	0.145	0.036	2.855	0.004	H3b support
Behavior	<---	Justification	0.030	0.045	0.447	0.655	H4b reject
Behavior	<---	Intention	0.270	0.05	3.926	***	H5 support

Note: *** p < 0.001.

were significantly related to behaviors, and these three variables explained 22.9% of AD behavior. Furthermore, standardized estimates, errors, and t-value of all the pathways of the proposed model are shown in Table 5.

Therein, although the path coefficient between attitude and intention was the lowest, it was still significant ($t = 2.985$, $p < 0.01$). The relationship between justification and intention had the highest path coefficient ($t = 15.385$, $p < 0.001$). These results indicated that justification was the strongest and attitude was the weakest but significant direct predictors of intention.

5. Findings and Discussions

The first finding revealed that over half of the engineering undergraduates self-reported never engaging in dishonesty in examinations, assignments, and plagiarism. The results from some previous studies sampling students from Chinese cultures [65–67] on the prevalence of AD were greater than the rates in the current study but consistent with a recent study [68]. The proportional difference between before and after these years may be attributable to the fact that Chinese universities and educational supervision authorities place a great priority on the academic integrity of students from higher education institutions. One possible reason for the decline is that China's Ministry of Education (MOE) has enacted and implemented several stipulations in recent years, and academic integrity institutional rules have been developed progressively in the university. For instance, MOE attaches importance to building a team of instructors for university students' ideological and political education courses. The latest data from the official website of the Ministry of Education shows that as of November 2020, the number of instructors engaged in ideology and politics in Chinese higher education institutions has exceeded one hundred thousand, with an average annual growth rate of 14.25%. For engineering students, Chinese scholars advocate the organic integration of ethical thinking education and professional foundation courses in teaching practice to develop comprehensive talents for society. Another reason may be the Chinese Socialist Core Values and Confucian culture have provided students with a basis for their moral judgments of AD behaviors. It is supported by the viewpoint of a recent cross-countries experiment that countries with Confucian culture were more honest in effort-based tasks in academic settings [69]. As a result, a decline in the number of students engaging in AD behaviors is a logical outcome.

In this empirical study, the extended form of TPB was employed by the researcher as a conceptual framework for the decision-making process that was applied to engineering undergraduates to construct their dishonesty intention and subsequent behaviors.

The result of CFA has validated every construct in the extended model, and fitness indices were used to provide information on the paths between the structural model's six primary constructs, correct paths that did not converge, and evaluate the goodness of fit of the model. As proposed, the second finding was that attitude, PBC, SN, and justification were significant immediate precursors of intention, and simultaneously, intention was the strongest direct antecedent for behavior, which was consistent with the previous empirical studies which use the TPB model [21, 26, 27, 36, 51, 55, 70], that supported the developed H1a to H4a and H5.

The third finding revealed that attitude and SN had a significant direct effect on the behaviors of AD, supported by the prior studies [6, 23, 27], which supported the developed H1b and H3b. Recently different cultural context research also verified that attitude significantly affects behaviors [25, 27, 43]. It indicated attitude could significantly affect students' intentions and behaviors. SN showed that students observed peer dishonesty and perceived important people's (i.e., parents, friends, teachers, etc.) integrity expectations to indicate their subjective norms. In Chinese universities, except for adult undergraduate courses, practically all undergraduate students are enrolled full-time and live on campus except for 2–3 months of annual vacation. Most importantly, the students with whom they have the most contact were their classmates, peers and teachers, they spend all their time together, and the impact of their interactions is immeasurable. In addition, according to earlier studies, one of the key facets in either preventing or encouraging cheating behaviors was their perceptions of peer influence [59, 71]. Therefore, SN is a direct predictor of AD behaviors, consistent with conclusions from previous studies [23, 25, 27].

Additionally, this study found that PBC and justification are not significant direct predictors for AD behavior, which is consistent with studies [9, 27, 43] that rejected the developed H2b and H4b. The researcher identified PBC as a social (external) construct, and the ability of students to achieve a given behavior was largely dependent on the degree to which the external environment hinders it. Justification is dependent on the reasons provided by the individual internal or external circumstances. The insignificant relationships reflect the diversity of intercultural teaching and learning settings. It implied that participants' perceptions of difficulty level and rationalization to engage in AD behaviors

in the learning process did not have a direct influence but via intention on their behavior.

Furthermore, the last but most important finding is that justification proved to be the most key predictive factor on intention, which is consistent with the study by [51]. It means that to justify or disregard the intentions of AD behaviors, the engineering students utilize neutralization strategies (e.g., denial, diverting blame to others, rationalization). And this mentality may give students reasons and excuses to justify their misbehavior and free them from feelings of guilt [1].

Especially most Chinese students grew up under the influence of good moral qualities, such as integrity, which are highly valued and socially expected in Confucian culture. Therefore, the inclusion of justification being a construct in the predictor of Chinese engineering students' intention of behavior of AD model was to reduce the psychological discomfort experienced and cognitive dissonance when the cheating behavior conflicts with their moral values that are in agreement, report truly and without psychological burdens and neutralize the negative impacts. Consequently, the addition of justification for behavior to predict these engineering undergraduates' intentions to execute the AD behaviors has a statistically significant effect on the extended model. Justification is a variable that deserves further attention, and it was shown that it significantly moderated the PBC-intention relationship [26] and was a mediator between three TPB predictors and behavior [23].

Hence, educational interventions to help students to develop good attitudes to academic integrity, instructional design methods that make students perceive it is hard to conduct dishonest behaviors in academia and cut down dishonesty possibility, and encourage students to report their peers' dishonesty and resist their justifications are valid means to reduce intents of academic violations thus prevent from committing misbehaviors.

6. Contributions, Limitations and Recommendations

This study contributes to the understanding of engineering undergraduates who are faced with ethical dilemmas and factors influencing their dishonest behaviors. It would offer a unique contribution to the Chinese empirical survey on academic integrity under the theoretical model. The theoretical contribution of this study was combined with the actual situations of engineering students in China, which added justification to the TPB model, which constructed a new model that enhances predictive ability. The study's practical significance is to help the related higher education institutions, educators, and policymakers develop a more proactive approach to nipping engineering undergraduates' intention to AD in the bud and enhance the moral quality of engineering students.

This empirical study has potential limitations. Though the data was collected in the context of four higher education institutions varied by institution type and region, the sample size was far from representative of the undergraduate engineering population in China. Thus, caution must be taken to interpreting the relationships between the constructs and generalizing the findings on a large scale. Future research is expected to contain samples of different quality levels to explore the potential causes and influencing factors.

7. Conclusions

The present study is one of the few cross-institutions empirical surveys that focus on the underlying factors contributing to AD behavior in the Chinese context of engineering undergraduates. The findings showed that attitudes, subjective norms, perceived behavioral control, and justifications could influence AD behavior directly and indirectly through the intention of behavior. The intention is proved to be the most solid predictive antecedent of the actual AD behavior. Hence, the findings suggest that helping Chinese and international engineering students develop the right attitude toward AD behaviors through educational means, encouraging them to report AD behaviors that occur around them, improving their learning climate to limit the opportunities for dishonesty, and constantly sanctioning infractions to reduce or defeat their intentions.

A highlight of the findings of this study is that justification has a significant impact on intention, if students adopt a neutralizing attitude to justify or rationalize their AD behaviors, they are more intentions in dishonesty. Penalty may be a useful approach, increasing the severity of consequences for dishonest behaviors may not allow students to rationalize their cheating/plagiarism behaviors as trivial. Those means could promote global engineering undergraduates' integrity in education and practice for sustainable development.

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Liu Xin Juan is a lecturer in School of Education at Baoji University of Arts and Sciences. She has earned her PhD degree in November 2022 at the Faculty of Education, Languages & Psychology, SEGi University in Malaysia. Her research interests are relatively broad: conflicts of interest, academic integrity, interdisciplinary education etc.

Zhang Bin is an information technology lecturer at Baoji University of Arts and Sciences. He is a PhD candidate at the Faculty of Arts, Computing and Creative Industry, Sultan Idris Education University (UPSI) in Malaysia. His research interests include cryptography, information security, Medical image processing, and engineering students' education.