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Research on the Impact of Academic Anxiety on Academic Achievement Among College Students Majoring in Industrial Design with an Engineering Background

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Abstract: The aim of this study is to explore the academic anxiety faced by students majoring in industrial design who enter the college entrance examination in the process of art learning and its impact on academic achievement. The research objective is to analyze the sources of academic anxiety in engineering industrial design students with weak art foundations during the learning process, explore the direct impact of academic anxiety on students' academic achievement, and propose possible intervention strategies. Educators should provide more personalized guidance and support measures for students with weak art foundations, helping them better adapt to the study of industrial design and improve their overall academic performance.

Keywords: The Student of Industrial Design with Engineering Backgrounds; Academic Anxiety; Academic Achievement; Effect Study

1. Introduction

1.1 Research Necessity

With the rapid advancement of global economies and technological innovation, industrial design has evolved into a critical driver of social innovation and economic growth. This field is no longer restricted to the aesthetic aspects of product design but extends to user experience, functionality, sustainability, and overall product lifecycle management [1]. In today's world, industrial design professionals must strike a balance between technical mastery and artistic creativity, requiring a deep understanding of both engineering principles and artistic expression [2].

Industrial design education, especially for students with an engineering background, presents significant interdisciplinary challenges. These students typically focus on STEM (Science, Technology, Engineering, and Mathematics) subjects during their high school education, which provides a solid foundation in technical knowledge but leaves them lacking in artistic training [3]. Upon entering university-level industrial design programs, students face the difficult task of acquiring artistic skills from scratch, which are crucial for success in design courses. These include competencies such as sketching, visual communication, and the use of design software, which not only enhance creative problem-solving but also directly impact academic achievement in design-related coursework [4].

However, mastering both technical and artistic skills simultaneously can generate significant academic pressure, particularly for engineering-oriented students. Many of these students struggle with the subjective nature of design evaluations, which often require high levels of creativity, innovation, and visual flair. This pressure frequently leads to heightened academic anxiety, particularly when students are confronted with the need to balance technical precision with creative expression [5].

Academic anxiety, as documented in educational psychology literature, is a psychological state characterized by feelings of tension, worry, and fear concerning academic tasks and evaluations. It has been widely recognized as a critical factor influencing students' mental health and overall academic performance [6].

In recent years, academic anxiety has garnered

increasing attention in the context of higher education, particularly in disciplines requiring both creativity and technical competence. Educators and researchers have called for greater awareness of the emotional and psychological challenges faced by students in these demanding fields [7]. In industrial design education, where success hinges on a blend of technical and creative abilities, academic anxiety can significantly undermine students' learning outcomes, affecting their motivation, concentration, and overall cognitive performance [8].

Given the growing significance of industrial design in the global economy and the increasing complexity of its educational demands, it is imperative to explore how academic anxiety impacts students with an engineering background. These students are often ill-prepared for the artistic components of industrial design courses, which leads to higher stress levels and poorer academic outcomes. Understanding the relationship between academic anxiety and academic achievement in this context is crucial for designing effective educational interventions that can support students' mental health, enhance their academic performance, and ultimately produce more well-rounded industrial designers capable of thriving in a competitive, interdisciplinary environment.

1.2 Purpose and Questions

Academic anxiety has been extensively studied in educational psychology, where it is recognized as a context-specific form of anxiety that affects students' emotional well-being, cognitive function, and academic outcomes [9]. In the case of industrial design education, particularly for students with an engineering background, academic anxiety arises from the significant gap between their technical skills and the artistic demands of the field [10]. Students entering these programs are often required to learn fundamental art skills rapidly while also meeting the high expectations set by design curricula. This gap in skills and expectations can lead to heightened anxiety, especially when students feel unprepared to meet the creative and subjective demands of their coursework.

Previous research has shown that academic anxiety not only impairs students' cognitive resources by diverting attention and reducing working memory but also decreases their motivation to engage with academic tasks [11]. This is particularly problematic in industrial design, where creativity and artistic expression are essential. As a result, students who experience high levels of anxiety may struggle to perform well in design projects and assessments, ultimately leading to lower academic achievement [12]. Moreover, the subjective nature of design evaluations, which often involve presenting personal creative work to peers and instructors, can exacerbate feelings of anxiety, further hindering performance [13].

The primary objective of this study is to explore the specific impact of academic anxiety on the academic achievement of industrial design students with an engineering background. Specifically, this research will employ quantitative methods to measure students' levels of academic anxiety and analyze its correlation with their academic performance in design courses. The working hypothesis is that higher levels of academic anxiety are associated with lower academic achievement. By investigating this relationship, the study aims to provide empirical data that can inform educators about the negative consequences of academic anxiety and help them develop interventions to alleviate its impact on student performance [14].

In addition to examining the direct relationship between academic anxiety and academic achievement, this study seeks to answer several key research questions:

Q1: What is the general level of academic anxiety among industrial design students with an engineering background? Are there significant differences in anxiety levels based on demographic variables such as gender or prior experience with art?

Q2: Is there a statistically significant correlation between academic anxiety and academic achievement in industrial design students?

Q3: What strategies can be employed to reduce academic anxiety and enhance academic performance among these students?

Addressing these questions will not only deepen the understanding of the factors influencing academic anxiety in industrial design education but also provide practical recommendations for educators and policymakers. Effective interventions, such as

personalized learning support, psychological counseling, and the integration of project-based learning strategies, can help reduce academic anxiety, improve academic outcomes, and promote the holistic development of students in interdisciplinary fields like industrial design [15].

2. Theoretical Background

2.1 A Review of Academic Anxiety

Academic anxiety refers to a psychological state of tension that students experience when dealing with academic tasks and academic pressure. This anxiety not only affects students' emotions and behavior, but also has a significant impact on their cognitive function and academic achievement [16]. Academic anxiety, as a situation specific anxiety, widely exists among students of different ages and academic backgrounds, and is an important topic in educational psychology research.

Academic anxiety is typically defined as the emotional distress and tension that students experience when faced with academic tasks. Spielberger (1980) proposed that academic anxiety is a specific manifestation of trait anxiety in academic contexts, involving fear of academic failure, worry about academic tasks, and anxiety about future uncertainty. This anxiety is not limited to exam situations, but can also manifest in various contexts such as homework, classroom performance, academic evaluations, and more.

Academic anxiety typically consists of two main components: cognitive anxiety and emotional anxiety. Cognitive anxiety involves concerns about failure, negative self-evaluation, and an excessive perception of task difficulty; Emotional anxiety manifests as physiological responses to academic tasks, such as increased heart rate, sweating, and discomfort in the stomach [17]. This emotional response is usually a direct reaction to stressors in academic contexts, such as exams, project presentations, etc., and may seriously affect students' attention and cognitive processing abilities.

In addition to the situational definitions mentioned above, academic anxiety is also considered a stable personality trait across contexts, manifested as individuals continuously experiencing anxiety in different academic contexts [18]. Individuals with trait based academic anxiety often exhibit high levels of anxiety in any academic task, regardless of the difficulty of the task. This trait anxiety not only affects their academic achievement, but may also have adverse effects on their long-term academic motivation and career development.

2.2 A Review of Academic Anxiety

Academic achievement is a core concept widely applied in the field of education, which measures students' performance and achievements in academic learning and educational processes. Although the definition of academic achievement varies in different cultures and educational systems, it usually involves evaluating students' level of knowledge mastery, ability development, and completion of academic tasks. Academic achievement is not only an important indicator for evaluating individual student progress, but also provides an important basis for educators, policy makers, and researchers to measure the quality of education and student learning outcomes.

In recent years, the definition of academic achievement has gradually expanded from a single quantitative evaluation standard to include a multidimensional evaluation system. This expanded definition reflects the emphasis on the comprehensive development of students in the field of education, surpassing the traditional mode of knowledge transmission and emphasizing the enhancement of students' abilities and the cultivation of their overall qualities in multiple aspects. Academic achievement is a multidimensional concept that encompasses various aspects of students' performance in academic learning. It not only includes traditional knowledge mastery and exam scores, but also encompasses students' critical thinking, creativity, social interaction skills, and emotional factors. With the continuous deepening of educational research, the definition of academic achievement is also constantly expanding and deepening, reflecting the diversification of educational goals and the emphasis on students' comprehensive development [19].

This comprehensive definition of academic achievement provides a more comprehensive perspective for educational evaluation, prompting educators to not only focus on students' academic performance, but also

consider their emotional, social, and behavioral development. This comprehensive evaluation method can better reflect students' actual abilities and potential, providing a scientific basis for the formulation of educational policies and the improvement of teaching methods.

In addition, the comprehensive definition of academic achievement also reminds us that the ultimate goal of education is not only to cultivate academic elites, but to promote the comprehensive development of students, enabling them to perform outstandingly in their future social and professional lives. This concept is gradually gaining recognition globally and has become an important guiding principle for modern education reform.

3. Research Methods

3.1 Research Subjects

This study aims to explore the relationship between the Academic Anxiety and Academic Achievement of College Students majoring in Industrial Design with engineering backgrounds.

The participants recruited a total of 938 undergraduate students, all of whom are currently studying industrial design with an engineering background. These students are distributed in various grades from freshmen to seniors, with freshmen accounting for 25% (234 students), sophomores accounting for 25% (235 students), juniors accounting for 25% (234 students), and seniors accounting for 25% (235 students). In terms of gender composition, male students accounted for 62.79% (589) and female students accounted for 37.21% (349) of the participants. The average age of the participants is 21 years old, ranging from 18 to 24 years old. The study also recorded the participants' family background, educational background, and academic achievements to control for confounding factors that may affect the research results. he main title (on the first page) should begin from the top edge of the page, centered, and in Times New Roman 16-point, boldface type. Capitalize the first letter of nouns, pronouns, verbs, adjectives, and adverbs; do not capitalize articles, coordinate conjunctions, or prepositions (unless the title begins with such a word). Please initially capitalize only the first word in other titles, including section titles and first, second-order headings (for example, “Titles and headings” — as in these guidelines). Leave two blank lines after the title.

3.2 Research Tools

3.2.1 Academic Anxiety Scale

This scale is based on the exam anxiety scale developed by Spielberger (1980), and has been modified in combination with the anxiety characteristics of industrial design students who cannot adapt to learning due to a lack of art foundation. The scale consists of 12 items, divided into three dimensions: cognition, emotion, and behavior.

Responses are scored on a 5-point Likert scale, with 1 indicating "strongly disagree" and 5 indicating "strongly agree." Higher scores reflect greater professional identity among student teachers. The overall cronbach's alpha coefficient for the scale is 0.947, with 0.913 for cognition dimension, 0.904 for cognition dimension, 0.922 for behavior dimension, indicating good stability and reliability of the scale.

3.2.2 Academic Achievement Scale

This scale is based on the research of Pajares and Valiante (1997) on academic achievement assessment, and has been modified in combination with the characteristics of the engineering industrial design major and the research topic of this study. The scale consists of 9 questions, divided into three dimensions: course grades, design work quality, and learning engagement.

The overall Cronbach's alpha coefficient for the scale is 0.936, with 0.901 for course grades, 0.916 for design work quality, and 0.927 for learning engagement, indicating good stability and reliability of the scale.

3.3 Data Analysis Method

This study utilized SPSS 26.0 for statistical analysis of the collected data. Descriptive analysis, independent sample t-tests were primarily employed to compare differences in gender, region, Art learning experience, academic achievement, Pearson correlation analysis was used to explore the relationship between Academic anxiety of students Students majoring in industrial design with an engineering background at normal university. Regression analysis was conducted to investigate whether The impact of academic

anxiety on academic achievement.

4. Research Results

4.1 The Analysis of Academic Anxiety, Academic Achievement of Students Majoring in Industrial Design with an Engineering Background

Descriptive statistical analysis was employed to examine the overall situation of the Academic anxiety, academic achievement of Students majoring in industrial design with an engineering background at normal university, with the results displayed in Table 1.

As shown in Table 1, the average score of cognitive dimension of academic anxiety is 3.07 (SD=. 56), emotional dimension of academic anxiety is 3.02 (SD=. 62), behavioral dimension of academic anxiety is 3.05 (SD=. 75), and the average score of academic anxiety is 3.14 (SD=. 83). The overall average score for academic achievement is 3.05 (SD=. 79), the average score for the course performance dimension of academic achievement is 3.03 (SD=. 76), the average score for design quality is 3.06 (SD=. 68), and the average score for learning engagement is 3.07 (SD=. 86).

Multivariate normality is determined by the magnitude of the absolute values of skewness and kurtosis. If the absolute value of skewness exceeds 3 and kurtosis exceeds 10, it is judged to be an inverse normality. The absolute value of Skewness measured in this study is within 3, and the absolute value of Kurtosis at all levels is within 10, which follows a normal distribution and can be used for subsequent research.

Table 1. Descriptive Statistics of Academic Anxiety, Academic Achievement of Students Majoring in Industrial Design with an Engineering Background (N=938)

Dimension	*Min*	*Max*	*M*	*SD*	*S(sk)*	*S(ku)*
CD	1.00	5.00	3.07	.56	.13	.84
ED	1.25	5.00	3.02	.62	.04	.35
BD	1.00	5.00	3.05	.75	.14	.32
AA	1.00	5.00	3.14	.83	.12	.63
CG	1.00	5.00	3.06	.76	.12	1.42
DWQ	1.00	5.00	3.03	.68	.11	.25
LE	1.00	5.00	3.17	.86	.17	.03
AAV	1.00	5.00	3.02	.79	.15	.07

Note. CD: Cognitive Dimension, ED: Emotional Dimension, BD: Behavioral Dimension, AA: Academic Anxiety, CG: Course Grades, DWQ: Design Work Quality, LE: Learning Engagement, AAV: Academic Achievement.

4.2 Analysis of Differences in Academic Anxiety, Academic Achievement of Students Majoring in Industrial Design with an Engineering Background on Demographic Variables

In this study, t-tests was utilized to compare the differences in Academic anxiety, academic achievement and its dimensions among normal students across gender, region. Detailed results are presented in Table 2.

Table 2. The Comparative Analysis of the Differences in Academic Anxiety, Academic Achievement of Students Majoring in Industrial Design with an Engineering Background with Different Demographic Variables (*M*±*SD*)

Dimension	Gender		*t*	Place of origin		*t*
	Male (*N*=349)	Female (*N*=589)		Urban (*N*=416)	Rural (*N*=522)	
CD	2.79±.65	3.16±.65	-8.011**	2.96±.61	3.03±.63	-2.341*
ED	2.72±.78	3.07±.88	-6.351*	2.65±.57	2.89±.64	-3.582*
BD	2.69±.86	3.11±.35	-7.315**	2.52±.83	2.92±.39	-2.774
AA	2.78±.65	3.32±.77	-7.436**	3.03±.96	2.73±.16	-3.938*
CG	3.76±.65	3.56±.61	7.436**	3.56±.61	3.02±.63	2.341**
DWQ	3.17±54	2.93±.62	5.534*	3.25±.79	2.92±.32	3.583*
LE	3.13±.59	2.98±.94	4.553*	3.12±.85	2.73±.78	2.774*
AAV	3.54±.57	3.19±.54	8.737**	3.67±.55	3.11±.58	3.938**

Note. * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Note. CD: Cognitive Dimension, ED: Emotional Dimension, BD: Behavioral Dimension, AA: Academic Anxiety, CG: Course Grades, DWQ: Design Work Quality, LE: Learning Engagement, AAV: Academic Achievement.

As shown in Table 2, Firstly, An independent sample t-test was conducted on industrial

design students with engineering backgrounds of different genders. The results showed that female industrial design students with engineering backgrounds had significantly higher academic anxiety and scores in the three sub dimensions (cognition, emotion, and behavior) than males.

College students majoring in industrial design with engineering backgrounds in rural areas score higher than urban students in academic anxiety and three dimensions.

An independent sample t-test was conducted on industrial design students with engineering backgrounds of different genders. The results indicate that male industrial design students with engineering backgrounds have significantly higher academic achievements and scores in the three dimensions than females. College students majoring in industrial design with engineering backgrounds in urban areas score higher in academic achievement and three dimensions than rural students.

4.3 The Correlation Analysis between Academic Anxiety and Academic Achievement of Students Majoring in Industrial Design with an Engineering Background

Table 3. Correlation Analysis of Academic Anxiety and Academic Achievement of Students Majoring in Industrial Design with an Engineering Background

Dimension	*M*±*SD*	1	2	3	4	5	6
1. CD	3.08±.85	1					
2. ED	3.12±.96	.476**	1				
3. BD	3.03±.32	.412**	.433**	1			
4. CG	3.02±.58	-.252*	-.341*	-.272*	1		
5. DWQ	3.06±.69	-.533*	-.361*	-.236*	.476**	1	
6. LE	2.98±.54	-.606*	-.576*	-.773*	.573**	.474**	1

Note. * $p<0.05$, ** $p<0.01$

CD: Cognitive Dimension, ED: Emotional Dimension, BD: Behavioral Dimension, CG: Course Grades, DWQ: Design Work Quality, LE: Learning Engagement.

The academic anxiety and achievement of industrial design majors with engineering backgrounds have a significant negative effect. The academic anxiety and motivation of industrial design majors with engineering backgrounds are significantly negatively correlated. The learning motivation of industrial design majors with engineering backgrounds has a significant positive impact on academic achievement. The results can be found in Table 3.

4.4 The Regression Analysis of Academic Anxiety and Academic Achievement of Students Majoring in Industrial Design with an Engineering Background

This study considered professional willingness, professional orientation, professional planning, and professional emotions within normal students' professional identity as predictor variables, and their core literacy as the outcome variable. The results can be found in Table 4.

Table 4. Regression Analysis of Academic Anxiety and Academic Achievement of Students Majoring in Industrial Design with an Engineering Background

Dimension	*VIF*	*Equ*	*B*	*SE*	*Beta*	*t*	R^2	*Adj.*R^2	*F*
AA	2.389	LIN	.652	.019	.746	28.929	.567	.570	805.348***
		QUA	.563	1.228	.632	6.121	.567	.570	355.214***
AAV	1.988	LIN	.672	.021	.733	20.631	.491	..494	479.702***
		QUA	.521	.129	.486	2.935	.493	.495	357.367***

Note. *** p<0.001

AA: Academic Anxiety, AAV: Academic Achievement.

The academic anxiety and achievement of industrial design majors with engineering backgrounds have a significant negative effect. The academic anxiety and motivation of industrial design majors with engineering backgrounds are significantly negatively correlated. The learning motivation of industrial design majors with engineering backgrounds has a significant positive impact on academic achievement.

5. Conclusion and Suggestions

5.1 Conclusion

This study aimed to investigate the relationship between academic anxiety and academic achievement among college students majoring in industrial design with an engineering background. Throughout the research, we explored the significant role that academic anxiety plays in affecting students' emotional, cognitive, and behavioral responses, particularly when these students face the dual challenges of mastering technical skills and developing artistic abilities. The findings reveal that academic anxiety negatively impacts academic performance, specifically in areas that require creativity, visual design, and subjective evaluations.

Engineering-background students in industrial design often struggle with balancing the technical and artistic demands of their curriculum. Their lack of foundational art skills adds to their anxiety, especially when they must quickly acquire these abilities to meet course expectations. The high levels of academic pressure lead to reduced attention span, lower working memory capacity, and diminished motivation, all of which contribute to suboptimal academic outcomes. Students with higher levels of academic anxiety consistently exhibit lower academic achievement, confirming the hypothesis that anxiety impairs academic performance, particularly in creative fields such as industrial design.

Additionally, the study highlights demographic factors such as gender and rural versus urban backgrounds, which further exacerbate academic anxiety in certain student populations. Female students and students from rural areas tend to experience higher levels of anxiety compared to their male and urban counterparts. These differences suggest that anxiety levels are not uniform and that personalized interventions are needed to address the unique needs of various student groups.

In conclusion, the negative correlation between academic anxiety and academic achievement in industrial design students underscores the importance of understanding and mitigating the psychological challenges faced by students in interdisciplinary educational environments. The findings contribute to the growing body of literature on the impact of academic anxiety and offer valuable insights for educators and policymakers aiming to improve student outcomes in complex, creative, and technical fields.

5.2 Suggestions

Based on the findings of this study, several suggestions are proposed to address academic anxiety and enhance academic performance among industrial design students with an engineering background.

Personalized Learning Support and Psychological Counseling: Educators should provide individualized guidance to students, particularly those who struggle with the artistic components of their curriculum. Offering targeted support, such as art foundation courses, can help students build confidence and reduce anxiety. Additionally, psychological counseling services should be made readily available to assist students in managing their stress and anxiety.

Incorporating Project-Based Learning: A project-based learning (PBL) approach can help students integrate their technical knowledge with creative design practices in a more applied, hands-on manner. PBL allows students to gradually build their artistic skills in real-world contexts, fostering a deeper understanding of design principles while reducing anxiety by breaking down complex tasks into manageable components.

Flexible Assessment Methods: To alleviate the pressure of subjective evaluations, educators should consider implementing more flexible and diverse assessment methods. These could include peer evaluations, iterative project submissions, and formative assessments that allow students to refine their work over time. Such methods would shift the focus from a single high-stakes assessment to a continuous learning process, which may reduce anxiety and improve overall performance.

Building a Supportive Learning Environment: Creating a classroom culture that encourages experimentation and values the learning process over the final product can significantly reduce academic anxiety. Instructors should emphasize that mistakes and revisions are a natural part of the creative process, thus alleviating students' fear of failure and promoting resilience in their academic journey.

Training Programs for Educators: Teachers and instructors should receive training on how

to recognize and address academic anxiety among students. Professional development programs can equip educators with the tools to identify signs of anxiety early and offer effective interventions. Teachers should also be encouraged to adopt a student-centered approach, where open communication and empathy form the foundation of their teaching practices.

Collaboration with Mental Health Professionals: Institutions should promote collaboration between educators and mental health professionals to create comprehensive strategies for reducing academic anxiety. This can include workshops, seminars, and stress management programs that educate students on coping mechanisms and time management skills, ultimately fostering a more balanced and productive learning environment.

By implementing these suggestions, educational institutions can reduce the impact of academic anxiety on industrial design students, fostering an environment that promotes both academic success and mental well-being. This will not only improve students' academic performance but also prepare them to thrive in their future careers, where the ability to manage stress and anxiety is crucial for long-term professional development.

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