Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #47735

Impact of financial anxiety and financial stress on the financial well-being of engineering graduate students in the United States

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Introduction

Financial well-being plays an important role in the mental health of graduate students. Millions of Americans are impacted by the significant and growing financial burden of the student loan debt crisis. In 2023, the total student loan debt reached approximately $1.75 trillion in the United States, affecting nearly 45 million borrowers [1]. The constant pressure to perform well in order to secure a job takes a toll on graduate students studying master's level courses in engineering, dependent on student loans. Under the burden of student loans, the experiences of financial anxiety and financial stress naturally occur and affect the financial well-being of students. This study focuses on graduate students in engineering, with a specific focus on master's level students, experiencing financial stress and financial anxiety due to high tuition fees, room, board, books, supplies, and transportation, among other expenses. Often, very few of them manage to obtain scholarships and assistantships to support their living, and a large number of students rely on student loans, which increases their financial anxiety and stress about repaying the loans after graduation.

Prior studies have focused primarily on undergraduate students, and master's students remain an understudied segment within the research. Among graduate students, doctoral students mostly manage to obtain assistantships, but master's level students often do not receive such financial assistance. As a result, the financial pressures on master's students in engineering can be particularly severe. The literature has highlighted several factors that contribute to financial stress and anxiety among college students, with student loans being a major source of this stress. Financial literacy and self-efficacy are important factors in college students' financial wellness, with higher levels associated with better financial behaviors and outcomes [2]. Financial stress and higher levels of self-reported student loan debt contribute to an increased likelihood of discontinuing college. However, students with the highest amount of university-reported student loan debt have a decreased likelihood of discontinuing college one year later compared to students with no student loan debt [3].

However, higher levels of financial anxiety are negatively associated with student loan repayment behaviors. Research has shown that higher objective financial knowledge is associated with better student loan repayment behaviors, but higher subjective financial knowledge is associated with worse repayment behaviors [4]. Moreover, first-generation college students report higher levels of financial anxiety compared to non-first-generation students. Students' self-concepts, such as perceived financial standing relative to peers and perceived mastery, have the largest contributions to financial anxiety. Meeting basic financial needs, such as having adequate income and the ability to cover expenses, is also important in reducing financial anxiety [5].

Financial satisfaction, particularly in the context of student loans, is a significant predictor of financial anxiety among college students, with higher financial satisfaction associated with lower levels of financial anxiety. While student loan debt was initially a significant predictor of financial anxiety, this relationship was no longer significant after controlling for demographic variables [6]. Individuals with student loans generally experienced lower financial well-being than those without loans. People who secured loans for themselves exhibited lower levels of financial well-being than other student loan holders, and were more

likely to experience anxiety about their student loans and were delinquent in their loan payments [7].

This study aims to investigate the current literature landscape on the financial well-being of engineering graduate students at master's degree level, with a focus on financial anxiety and financial stress related to student loans. The findings will inform policies that support students' financial well-being and help educational leaders better understand and address the financial challenges faced by students in master's programs.

Methodology

This study employs a scoping review approach, which helps in the initial examination of the potential breadth and depth of the existing research literature. It involves identifying the nature and scope of research evidence available, including ongoing studies [8]. In this paper, we intend to employ a scoping review of financial anxiety and financial stress and its impact on student's financial well-being due to student loans within the context of engineering graduate students, specifically at the master's level.

This study follows a five-stage framework by Arksey and O'Malley, which provides a robust and systematic approach to conducting scoping reviews. Scoping review studies can help researchers to examine the extent, range and nature of research activity; understand the value of undertaking a full systematic review; summarizing and disseminating the research findings; and identify research gaps in the existing literature.

Stage 1: Identifying the research question
Stage 2: Identifying relevant studies
Stage 3: Study selection
Stage 4: Charting the data
Stage 5: Collating, summarizing and reporting the results

Apart from the five-stages highlighted above, the framework also provides an optional stage for 'consultation', helping to inform and validate the findings from a scoping review. Evidence suggests that systematic reviews can be enhanced, and useful results can be drawn, if consumers and practitioners contribute their insights in the review process [9].

In this study, we have considered all five-stages of the scoping review framework discussed above. In Stage 1, the research question is identified for the study, which sets a roadmap for conducting the search for the following stages. Stage 2 involves identifying the relevant studies, specifically those pertinent to our research question. In the next stage, the study selection process is conducted, outlining the inclusion and exclusion criteria. The studies that seem to be the best-fit with the research question are considered for the review. In Stage 4, key information is charted from the extracted selected studies, which helps in further analysis. Finally, the last stage involves collating, summarizing and reporting the findings to systematically address the existing evidence related to the research question. Furthermore, Table 1 outlines the research stages based on the framework discussed above.

Table 1: The Five Stages Framework of an Scoping Literature Review (based on Arksey & O'Malley, 2005)

Stage	Description	Outlined tasks as per research plan
1	Identifying the research question	Focuses on understanding the current landscape of literature on the financial well-being of engineering graduate students at master's degree level, with a focus on financial anxiety and financial stress related to student loans in the United States.
2	Identifying relevant studies	A systematic search across interdisciplinary databases including engineering and business databases (Engineering Village, Web of Science, PsycINFO, IEEE Xplore, EBSCO Business Source Complete, and ERIC).
3	Study selection	A web-based software tool, named 'Rayyan', was utilized, which helps to conduct systematic literature reviews. The studies were screened in two phases using these screening criteria – title review, followed by abstract reviews. The extracted studies followed a clear inclusion and exclusion criteria detailed in Table 3.
4	Charting the data	Identifying key details from the selected studies, including authors, year of publication, methodology, theoretical framework, main findings and summary were charted using Excel spreadsheet.
5	Collating, summarizing and reporting the results	Collecting, synthesizing and presenting the summary of the research findings to systematically address the research question.

STAGE 1: Identifying the research question(s)

The research question was formed in this stage that guided our scoping review study: *What is the current landscape of literature on the financial well-being of engineering graduate students at master's degree level, with a focus on financial anxiety and financial stress related to student loans?*

Based on this research question, we defined our Population-Concept-Context (PCC) framework, which further guided the inclusion and exclusion criteria of our study. We defined the precise terms structured within this framework. Table 2 outlines the PCC framework that we used to define our concept lines.

Table 2: Population-Concept-Context Framework

Framework	Details
POPULATION	Engineering Master's students (graduate students)
CONCEPT	Financial Anxiety/ Financial Stress/ Student Loans/ Financial well-being
CONTEXT	US - Engineering and STEM Literature

Further Table 3, clearly outlines the inclusion and exclusion criteria for our study's scoping review. The study used the parameters below for evaluating and selecting the focused search results that align with the research question.

Articles were selected for final review only if they met all inclusion criteria. To enhance clarity, checkmarks '✓' are used to denote when an article satisfies either an inclusion criterion or an exclusion criterion. Cells are left blank if the criterion does not apply or is unmet. Specifically:

- A checkmark in the inclusion criteria column indicates the article fulfills that requirement.
- A checkmark in the exclusion criteria column signals the article meets a disqualifying factor.

Table 3: Inclusion and Exclusion Criteria for the Scoping Review

Criteria	Included	Excluded
Peer Reviewed Articles, Conference Papers and Grey Literature (Dissertations)	✓	
Retracted Papers		✓
Studies Outside the US		✓
Written in English	✓	
Only Master's level students (graduate students)	✓	
Not related to Engineering and the Concept		✓
Falling Outside the Specified Timeline		✓

In this stage, we included the articles that were peer reviewed journal publications, conference papers, conference proceedings, along with grey literature (dissertations). The papers retracted from any of these categories were excluded. We excluded all other types of studies such as book chapters, magazine articles, literature reviews, reports, etc. The studies conducted outside the US, not written in English, not within the specified time period (from January 2000 to December 2024), not related to engineering or STEM disciplines, and lastly not related to the concept (financial anxiety, financial stress, etc.) were all excluded from the scoping review.

STAGE 2: Identifying relevant studies

We employed a systematic search strategy across six databases: Engineering Village, Web of Science, PsycINFO, IEEE Xplore, EBSCO Business Source Complete, and ERIC. These databases were selected with the guidance of a librarian. Collectively, these databases cover a wide range of disciplines related to the research question, including engineering, technology, social sciences, arts, humanities, clinical psychology, education, economics, finance, and educational psychology.

The search terms for this paper were organized in three different concept lines. A concept line, as we define it, is a structured approach to organize our search strategy, which helps to group the related terms and concepts together. It is a criterion that shares a similar definition or meaning to the proposed keyword. We utilized the same concept lines and keywords across all the six databases to get the desired research results based on our research question.

The keywords and concept lines were inspired by previous research, which enhanced the research rigor [10-11]. For the comprehensive search across the databases, we used the combined keyword search string with Boolean operators for the *Concept variable* of our study, that includes financial anxiety, financial stress, student loans and financial well-being. The Population and Context variables were used as the remaining two concept lines. Table 4

outlines the concept lines and keywords that we utilized in this study. These concept lines, keywords and Boolean operators (which include 'AND', 'OR') were similar across all the six databases that we used.

Table 4: Concept Lines and Keywords utilized in our study

Concept Lines	Keyword Search String with Boolean Operators
Graduate Searching literature that relates to master's students at a college or university.	"university student" OR "college student" OR "graduate student" OR "grad student" OR "post-graduate student" OR "postgraduate" OR "master's student" OR "masters student" OR master* OR "master student" OR "student" OR grad* OR postgrad*
Engineering Focusing on research articles related to Engineering and STEM field.	"engineering" OR engineer* OR "engineers" OR "STEM" OR "engineering sciences" OR "engineering studies" OR "engineering graduate" OR "engineering discipline" OR "engineering education" OR "engineering grad school"
Financial Anxiety Focusing on research articles related to Financial Anxiety.	"financial anxiety" OR "financial worry" OR "money anxiety" OR "financial-related anxiety" OR "economic anxiety" OR "monetary anxiety" OR "financial concern" OR "money-related stress" OR "financial distress"
Financial Stress Focusing on research articles related to Financial Stress.	"financial stress" OR "economic stress" OR "financial hardship" OR "financial pressure" OR "monetary stress" OR "economic burden" OR "financial strain" OR "financial insecurity" OR "money management stress" OR "financial difficulties"
Financial Well-Being Focusing on research articles related to Financial well-being.	"financial well-being" OR "financial wellbeing" OR "economic wellbeing" OR "economic well-being" OR "financial satisfaction" OR "income satisfaction" OR "financial health" OR "financial wellness"
Student Loans Focusing on research articles related to student loans or graduate loans.	"student loan" OR "education loan" OR "college loan" OR "university loan" OR "graduate loan" OR "student debt" OR "education debt" OR "graduate student loans" OR "master's loan" OR "graduate students loan" OR "loan repayment" OR "debt burden"

The authors conducted a blind review of the research articles in the two-stages across databases, which included title screening followed by abstract screening. Through this search, 735 unique articles were identified that formed the basis for the further selection process. Next section of the paper focuses on screening and selecting the studies. The study uses Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram that outlines the study's complete search and screening process depicted in Figure 1.

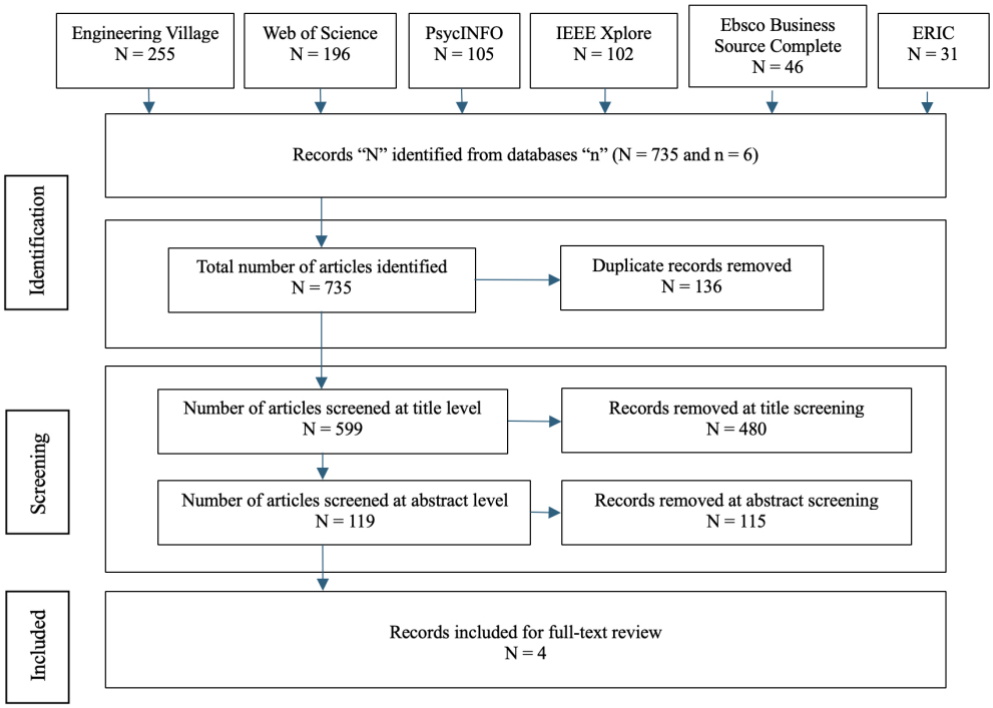

Figure 1: PRISMA flow diagram outlining articles search and screening process

STAGE 3: Study selection

In this stage, we screened the articles in three stages: (a) title screening, (b) abstract screening, and lastly, (c) full-text screening. Studies that did not meet one or more of our inclusion criteria were excluded from the review. For data collection, we combined all three concept lines across all the six databases to get the research articles related to our research question. These lines are related to the graduate student's (specifically at the master's level), engineering and STEM disciplines, financial anxiety, financial stress, financial well-being and student loans. We retrieved a total of 735 articles from 6 databases, while conducting our scoping review (Engineering Village, N = 255, Web of Science, N = 196, PsycINFO, N = 105, IEEE Xplore, N = 102, EBSCO Business Source Complete, N = 46, and ERIC, N = 31). These articles were further screened using Rayyan software, and 136 duplicates were identified, which were removed from further analysis. After removing duplicates, we were left with 599 unique articles which underwent further screening, including the title and abstract screening. At the title screening level, 480 articles were excluded and we were left with 119 articles for abstract review. From these, we excluded 115 articles in the abstract screening, and finally we were left with 4 unique articles that met our inclusion criteria, which primarily focused on financial anxiety and financial stress faced by engineering master's students in the United States due to student loans and its impact on their financial well-being.

STAGE 4: Charting the data

In this stage, we retrieved the full-text information of all the selected four articles. The key details from these selected studies were taken, such as: authors, year of publication, methodology, theoretical framework or theory used, main findings, and summary of the studies. These details were further charted using an Excel spreadsheet. Table 5 provides a summary of information for the four studies considered in the review, including their focus, participants, institutional details, and keywords.

Table 5: Summary of information for the four selected studies

Paper Title, Author (Year)	Focus	Participants and Institutions	Keywords
Wallet Weight: An Instrument Development Study for Measuring Financial Stress in College Students Using a Design-Based Research (DBR) Approach - Dara Nikauri Bright (2023)	Development and validation of a new instrument called the College Students' Financial Stress (CSFS) survey.	College students and subject matter experts (SMEs) who were involved in the qualitative field-testing and development of the CSFS survey.	Financial stress, college students, DBR approach
College Stress Impacts Mental Health and Relationship Satisfaction - Kelly Noelle Campbell (2021)	Examine the relationship between college stress, mental health, and relationship satisfaction among college students.	College students, both undergraduate and graduate, who were recruited from Tennessee State University (TSU) as well as outside of TSU.	College stress, students, mental health, relationships, satisfaction
Achieving the Promise of Educational Opportunity: Graduate Student Debt for STEM vs. Non-STEM Students - Rachel Burns and Karen L. Webber (2019)	Examine the differences in graduate student debt between STEM and non-STEM students enrolled in master's and doctoral degree program.	11,430 graduate students enrolled in 2012. The study used data from the 2012 National Postsecondary Student Aid Study (NPSAS), the Integrated Postsecondary Education Data System (IPEDS), and the Delta Cost Project (DCP).	Graduate students, graduate school debt, STEM, NPSAS
Examining the Explanatory Variables that Impact Graduate Engineering Student Enrollment - Manoj K. Jha and Reginald L. Amory (2012)	Explores key socioeconomic factors influencing graduate engineering student enrollment in the U.S. by analyzing enrollment patterns at major universities.	Engineering degree recipients from Morgan State University. The study also examines data from major U.S. universities regarding international student enrollment patterns.	Graduate students, engineering programs, student enrollment

STAGE 5: Collating, summarizing and reporting the results

In the final stage, the key findings from the final four articles were considered. The authors individually screened these full text-papers and found the key findings, as explained below for each article.

The study *Wallet Weight: An Instrument Development Study for Measuring Financial Stress in College Students Using a Design-Based Research (DBR) Approach* by D.N. Bright (2023) focuses on the development and validation of the College Students' Financial Stress (CSFS) survey to measure the financial stress experienced by undergraduate students. Using a rigorous design-based research (DBR) methodology, the study employed a mixed-methods approach, incorporating qualitative data from cognitive interviews and subject matter expert (SME) feedback, as well as quantitative data from field testing and Rasch measurement analysis to iteratively refine and validate the survey.

The key findings of the study were that the College Students' Financial Stress (CSFS) survey developed in the study had good psychometric properties, including good separation between persons and items, good fit, excellent unidimensionality, and appropriate item targeting. Results further reveal that students experiencing high financial stress may develop a sense of hopelessness and engage in drastic behaviors, highlighting the critical need for identifying at-risk individuals. The survey serves as an important tool for measuring students' perceptions of financial safety and recognizing those at greater risk of financial stress and dropout. The study is grounded in theoretical frameworks such as the Stress Process Model (SPM), the Generalized Unsafety Theory of Stress (GUTS), and the Diathesis-Stress Model, which help contextualize financial stress as a significant psychological and situational burden on students [12].

K.N. Campbell's (2021) study, *College Stress Impacts Mental Health and Relationship Satisfaction,* was focused on students at all the levels, which includes associate, bachelor's, master's and doctoral. It explores the relationship between college stressors, mental health, and relationship satisfaction among college students. Using a quantitative, survey-based approach, the study recruited both undergraduate and graduate students from Tennessee State University and outside of TSU through convenience sampling. The data analysis employed multiple regression, MANOVA, and logistic regression. It was found that financial stress did not have the greatest impact on mental health (anxiety), but rather academic and social stress had a greater impact. Also, there was no significant difference in college stress between undergraduate and graduate students.

Findings indicate that there were no significant correlations between financial stress and anxiety; however, academic and social stress impacted anxiety levels. Further, depression has a stronger negative impact on relationship satisfaction than anxiety when college stressors were present, with this association being more pronounced in women than men. Additionally, relationship characteristics such as length, investment, commitment, and quality of alternatives were linked to both relationship satisfaction and depression, though these associations varied by gender. The study draws on theoretical frameworks like Thoits' (1995) Stress Carryover Theory and Bodenmann's (1995) Stress-Divorce Model to contextualize how stress from academic pressures can influence both mental health and romantic relationships [13].

The next article by Burns and Webber (2019), *Achieving the Promise of Educational Opportunity: Graduate Student Debt for STEM vs. Non-STEM Students,* considered students both at master's and doctoral level in STEM and Non-STEM disciplines and explores the

disparities in graduate student debt between STEM and non-STEM students, highlighting significant financial differences that may influence enrollment decisions and broader economic outcomes. Using data from the 2012 National Postsecondary Student Aid Study (NPSAS), the Integrated Postsecondary Education Data System (IPEDS), and the Delta Cost Project (DCP), the study analyzed a nationally representative sample of approximately 11,430 graduate students, representing an estimated 2,723,550 students. The study employed a zero-censored Tobit model to address the overdispersion of zeroes in borrowing amounts, and is grounded in Human Capital Theory and Rational Choice Theory.

The findings revealed that non-STEM doctoral students accumulated $20,013 more in graduate debt compared to their STEM counterparts. Additionally, within STEM fields, female graduate students borrowed $9,437 more than male students, underscoring gender disparities in financial burden. Additionally, individual characteristics such as race/ethnicity, marital status, and enrollment intensity influence graduate debt differently for STEM and non-STEM students. Lastly, institutional characteristics such as control, finances, and size also influence graduate debt, with students at private institutions and smaller institutions borrowing more [14].

The fourth article by Jha and Amory (2012) *Examining the Explanatory Variables that Impact Graduate Engineering Student Enrollment*, provides a comprehensive summary of the factors contributing to the wider gap between domestic and international student enrollment in U.S. graduate engineering programs and identifies key socioeconomic factors responsible for the reluctance of U.S. born students to pursue graduate engineering education. The methodology includes a literature review to understand the disparity in enrollment trends of U.S. born students at the undergraduate and graduate levels, analysis of enrollment data at major U.S. academic institutions using Cornell University as an example, surveys of both U.S. and international engineering students to understand the key factors influencing their decisions to pursue graduate education, and the authors' own observations and experiences, particularly regarding the socio-cultural system in India and its impact on STEM education.

The findings indicate that the gap between domestic and international student enrollment in U.S. graduate engineering programs is much wider than the gap at the undergraduate level. Key socioeconomic factors contributing to the reluctance of U.S. born engineering bachelor's degree recipients to pursue graduate school immediately upon graduation are: (1) immediate earning potential, (2) economic status of family, and (3) student loan burden. In contrast, the key factors attracting international students, especially from Asian countries, to pursue graduate degrees in the U.S. are: (1) quality and marketability of U.S. education, (2) availability of graduate assistantships/fellowships/scholarships, and (3) job opportunities and plans to stay in the U.S. upon graduation [15].

Discussion

This study aims to answer the research question: *What is the current landscape of literature on the financial well-being of engineering graduate students at master's degree level, with a focus on financial anxiety and financial stress related to student loans?* This research question helped us define the inclusion and exclusion criteria for the scoping review, which in turn, helped to define the concept lines and keywords for search across six databases, and finally the search resulted in selection of four unique articles related to the research question. Due to the stringent inclusion requirements (e.g., peer reviewed articles, conference papers, grey literature, US graduate student population, no retracted papers, engineering or STEM students, English

written papers, published within January 2000 and December 2024), this small number may be explained. Nevertheless, these papers provided insightful information.

We conducted the full text analysis of these four articles, and charted the findings in an Excel spreadsheet, summarizing the details. During the full-text analysis, it was observed that all the four studies focused on different aspects of student populations in higher education. One study specifically targeted undergraduate students up to their fifth year, analyzing their academic experiences and outcomes. The second study broadened its scope to include students at all levels, including associate, bachelor's, master's, and doctoral students, providing a comprehensive view of the educational landscape. The third article concentrated on master's and doctoral students in both STEM and non-STEM fields, exploring the unique challenges, and opportunities they face. Further, the fourth study examined both U.S. students and international students enrolled in graduate engineering programs, highlighting the diversity of experiences within this specific domain.

However, none of the studies exclusively focused on graduate engineering student population in the U.S., specifically at master's level. Additionally, these studies were directly unrelated to the research question we were trying to address. Therefore, there remains a significant gap in the existing literature on this topic which demands attention in this area. This study is one of its kind and focuses on this niche area, aiming to add to the current literature landscape related to financial anxiety and financial stress faced by the U.S. engineering graduate students due to student loans, and consequently impacting their financial well-being.

For other professional masters programs such as MBA, JD, MD, etc., it is true that these programs also have instances of high tuition fees which force students to borrow students loans. Students in these programs face similar financial stress and anxiety to repay their student debt. However, in this study, our scope is uniquely limited to engineering master's students, and future studies can explore similarities and differences among different master's professional degree programs.

The study has implications for students in master's programs to improve student well-being and will generate knowledge for leadership in colleges and educational institutions to better understand students' financial situations.

Acknowledgements

We sincerely thank librarian [...] for her guidance, and dedicated support throughout the process of research article retrieval, database searches, and the development of Boolean strings. Her support was instrumental in the successful completion of this study.

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