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A Questionnaire Survey of Student Engagement Among First-Generation College Students in Engineering

Abigail Lehto
Utah State University

A QUESTIONNAIRE SURVEY OF STUDENT ENGAGEMENT AMONG FIRST-GENERATION COLLEGE STUDENTS IN ENGINEERING

by

Abigail Lehto

A thesis submitted in partial fulfillment

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Approved:

_____	_____
Ning Fang, Ph.D. Major Professor	Cassandra McCall, Ph.D. Committee Member
_____	_____
Marissa Tsugawa, Ph.D. Committee Member	D. Richard Cutler, Ph.D. Vice Provost of Graduate Studies

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ABSTRACT

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by

Abigail Lehto, Master of Science

Utah State University, 2023

Major Professor: Ning Fang, Ph.D.
Department: Engineering Education

First-generation college students tend to face more overall challenges in the college environment than their continuing-generation counterparts. Often, first-generation students have lower grade-point-averages (GPAs) and are less likely to graduate than their peers. In majors like engineering, the struggles that first-generation college students face can be further magnified. This quantitative study examines the activities first-generation college students in engineering engage in according to the National Survey of Student Engagement (NSSE). The overall goal of this study is to identify activities that FGC students engage in that contribute to academic success by answering the following research questions:

1) What is the engagement experience for first-generation college students in engineering at Utah State University?
2) Do different categories of engagement correlate to one another for first-generation college students in engineering? If so, how?

3) Does engagement experience relate to GPA for first-generation college students in engineering at Utah State University? If so, how?

Questions from the NSSE are categorized into ten engagement indicators (EIs) that contribute to four themes. The engagement indicators are higher-order learning, reflective and integrative learning, learning strategies, quantitative reasoning, collaborative learning, discussions with diverse others, student-faculty interaction, effective teaching practices, quality of interactions, and supportive environment. The themes are academic challenge, learning with peers, experiences with faculty, and campus environment.

A sample of 28 sophomore, junior, and senior engineering students of various disciplines at Utah State University was obtained for this research via a pre-screening survey. Participants completed the NSSE and received compensation for their time. Survey data was organized, responses to questions were grouped into EIs, and then EIs were grouped into themes. A total score was calculated for each participant based on the ten engagement indicators and the four themes. The distribution of the total score data was determined. Depending on if the results showed parametric or non-parametric characteristics, a Pearson or Spearman correlation was completed.

The results showed significant correlations between three of the four themes and many significant positive correlations between engagement indicators. Of the themes and engagement indicators, the supportive environment engagement indicator showed a significant positive correlation with student GPA. These results can be used to inform FGC students in engineering and educators of engagement activities that relate to one another and relate to academic success.

Limitations of this research include a smaller sample and the possible effect of the COVID-19 pandemic on activities available to students. Future work for this research would include a qualitative study where participants are interviewed for further questioning and better understanding

(97 pages)

PUBLIC ABSTRACT

A QUESTIONNAIRE SURVEY OF STUDENT ENGAGEMENT AMONG FIRST-GENERATION COLLEGE STUDENTS IN ENGINEERING

by

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First-generation college (FGC) students are defined as students whose parents do not have a bachelor's or graduate degree. FGC students tend to face more overall challenges in the college environment than their continuing-generation counterparts. Often, FGC students have lower grade-point-averages (GPAs) and are less likely to graduate than their peers. In majors like engineering, the struggles that first-generation college students face can be further magnified. This quantitative study examines the activities FGC students in engineering engage in based on the National Survey of Student Engagement (NSSE). Questions from the NSSE cover different educational activities and are categorized into ten educational engagement indicators (EIs) that contribute to four educational themes. The overall goal of this study is to identify activities that FGC students engage in that contribute to academic success by answering the following research questions:

1) What is the engagement experience for first-generation college students in engineering at Utah State University?
2) Do different categories of engagement correlate to one another for first-generation college students in engineering? If so, how?

3) Does engagement experience relate to GPA for first-generation college students in engineering at Utah State University? If so, how?

A sample of 28 sophomore, junior, and senior engineering students of various disciplines at Utah State University was obtained for this research via a pre-screening survey. Participants completed the NSSE and received compensation for their time. Survey data was organized, responses to questions were grouped into EIs, and then EIs were grouped into themes. A total score was calculated for each participant based on the ten engagement indicators and the four themes. The distribution of the total score data was determined to apply appropriate correlational tests.

The results demonstrated significant correlations between three of the four themes and within the engagement indicators. Of the themes and engagement indicators, the Supportive Environment engagement indicator showed a significant positive correlation with student GPA. These results can be used to inform FGC students in engineering and educators of engagement activities that relate to one another and relate to academic success.

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Abigail Lehto

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CHAPTER 1

INTRODUCTION

1.1 Positionality

The author of this thesis is a continuing-generation college student in engineering. The author is viewing the overall study, results, and conclusions of this thesis from this perspective. Many of the author's perceptions of the undergraduate college environment were reinforced by her parents and family as she navigated this environment herself.

1.2 Rationale

This research explores engagement among first-generation college (FGC) students in engineering. Student engagement has many different categorizations based on activities both within and outside of the classroom. Examples of classroom engagement include helping another student understand course material or asking questions, while examples of out-of-class engagement include joining a club, or working on campus. Another aspect of student engagement includes students' relations with others. Activities like discussing post-college plans with a professor or advisor or forming a study group with students whom a student has multiple classes with are also examples of student engagement. Studies have shown that students reported 7% more cognitive engagement and 3% more behavioral engagement in classrooms where instructors focused on engagement by activating prior knowledge, facilitating classroom interaction, and promoting reflection (Hilpert & Husman, 2017). Practices like these get students involved in their learning beyond passive learning.

In general, first-generation college students engage in the same academic activities as their continuing-generation peers (Pike & Kuh, 2005). However, they engage in academic

activities less than continuing-generation students and perceive college environments to be less supportive (Pike & Kuh, 2005) resulting in increased stress on academic goal progression (Garriott & Nisle, 2018). First-generation college students are 6% less likely to complete college with a STEM degree and tend to switch majors more often than continuing-generation students (Bettencourt et al., 2020; Shaw & Barbuti, 2010). With these factors in mind for first-generation students in general, it is imperative to look at student engagement in engineering courses, activities, and how these relate to students' academic success. A common measurable attribute of academic success is student grade-point-average (GPA). Studies show a 0.15-point difference in GPA between first and continuing-generation STEM students, with continuing-generation students having the higher GPA (Thompson, 2021). For FGC students in engineering, this difference in GPA could decide admission into professional programs, or influence students obtaining and keeping scholarships.

As a continuing-generation student, a lot of the time parents will send their children to college with potential sources of in and out-of-classroom engagement in mind. As a first-generation student, the student may have these sources in mind, but they are often stemming from other places with potentially less influence. First-generation students tend to struggle more than continuing-generation students in terms of academic success, especially in STEM majors (Bettencourt et al., 2020; Shaw & Barbuti, 2010). Engineering is perceived to be one of the more difficult areas of study in colleges, and first-generation students do not have the same advantage that continuing-generation students have in terms of guidance from their parents or guardians.

This thesis research has the potential to provide first-generation students with knowledge about their engagement, and how it can help them excel in college.

1.3 Research Purpose and Research Questions

The goal of this thesis is to capture a preliminary picture of student engagement among first-generation college students in engineering majors at Utah State University. Specifically, this research sought to answer the following research questions:

1. What is the engagement experience for first--generation college engineering students pursue at Utah State University?
2. How do different categories of engagement correlate to one another for first-generation college students in engineering?
3. How does engagement relate to GPA for first-generation college students in engineering at Utah State University?

To achieve this goal and answer these research questions, we first surveyed first-generation college students in the College of Engineering at Utah State University using the National Survey of Student Engagement (NSSE) (Indiana University, 2017, 2013; McCormick et al., 2013). We then identified relationships between NSSE specified engagement indicators and overall engagement scores.

1.4 Research Design

This research aims to give a preliminary picture of the engagement of first-generation college students in engineering at Utah State University. As such, this research employs a quantitative research design where survey data was collected and analyzed to gain a basic understanding of first-generation engineering students' engagement habits. We chose a

quantitative over a qualitative research design based on the availability of a robust survey instrument that was validated and shown as reliable: the National Survey of Student Engagement (NSSE). Further, quantitative research designs are most used to understand student engagement which can support findings from this study (Ives & Castillo-Montoya, 2020). The NSSE asks students to self-report different aspects of their engagement. This method focuses on specific activities students engage in which in turn helps to achieve the goals for this research and answer our research questions. This quantitative method develops a preliminary picture of student engagement that can be leveraged in designing a qualitative research design to support and expand on quantitative findings. When this quantitative picture is obtained, a more qualitative approach can be pursued in future work, using the initial quantitative results as a basis.

1.5 Significance

This research provides a preliminary picture of engagement for first-generation college students in engineering at Utah State University (USU). Utah State University is a rural school with a high population of FGC students. The activities that students at USU are engaging in may be different because of the geographical location of USU and the fact that many students attending USU commute to school each day from surrounding areas. As such, this research provides unique insight to engagement activities of FGC students in engineering.

On a larger scale, this research provides a foundation for educators to be able to help aid first-generation students in engineering and bridge the current gaps between first- and continuing-generation students GPA and FGC students leaving STEM majors (Bettencourt et al., 2020; Shaw & Barbuti, 2010; Thompson, 2021). If specific engagement practices

contribute more to academic success, then these practices can be encouraged, implemented, and made more available to students. As an educational community, we want every student to have the opportunity to succeed and excel in engineering majors, and this research takes steps to be able to make that happen.

1.6 Key Terms

Three main definitions exist that categorize a student as a first-generation college student: 1) students whose parent(s) or guardian(s) have not attained a high school education or higher, 2) students whose parent(s) or guardian(s) have not attained an associate degree or higher, and 3) students whose parent(s) or guardian(s) have not attained a bachelor's degree or higher (Atwood et al., 2020). All three of these definitions are contingent on neither parent nor guardian having attained the degree in question. Research on these definitions shows no change in statistical significance depending on the definition used (Atwood et al., 2020). This research utilizes the most common definition for first- and continuing-generation students: "'First-generation' is defined as students for whom no parent has a Bachelor's degree; 'continuing-generation' is defined as students whose parent(s) have a Bachelor's or graduate degree" (Atwood et al., 2020, p. 8).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Current research on the student engagement of first-generation college students in engineering mainly focuses on student engagement as a big idea that can be related to other variables such as persistence. This research, focusing on student engagement of first-generation college students in engineering at Utah State University, aims to examine specific activities FGC students in engineering are engaging in, and relate those activities students' academic success We believe that the focus of this research will best serve to bridge the research gap by providing an inclusive picture of what activities and practices students are engaging in, and how those activities and practices relate to students' academic success at Utah State University. This literature review first describes what student engagement means, then presents literature on first-generation college students and student engagement which fall into several categories: 1) first-generation students and student engagement, 2) first-generation STEM students in general, 3) first-generation engineering students in general, and 4) first-generation engineering students and student engagement.

2.2 Student Engagement in Higher Education

Student engagement includes many activities that students participate in every day. Engagement can take place both in and out of the classroom, and for some students, engagement happens without them even knowing it. An example of student engagement in the classroom may be asking a question or participating in a discussion. An example of out-of-class engagement may be creating a study group with peers, or reviewing notes after class.

A study completed in 2008 utilized the NSSE to compare engagement of engineering students to engagement of students in other majors. Findings from this study suggest that the NSSE measures student engagement at an institutional level (Ohland et al., 2008). Ohland also acknowledges that students' responses to the NSSE are reflecting their experiences with courses and faculty, and it is possible that this could vary depending on department (2008). This study also describes student engagement as an indication of students' taking part in practices that are educationally effective (Ohland et al., 2008).

In a recent article comparing STEM and non-STEM student engagement across the top 100 US institutions, a study found that STEM students engaged less in integrative and reflective learning than non-STEM students (Nelson Laird et al., 2011). Thinking about the nature of most STEM degrees, this result about STEM students is surprising. The research does not focus on first-generation students; however, the generalized result calls into question what activities students are engaging in. This thesis research looks use a more specific sample, and shed light on how different engagement activities relate to one another.

2.3 First-Generation Students and Student Engagement in Higher Education

Many studies outside of engineering-specific contexts looking at the engagement of first-generation college students focused on one type or aspect of engagement rather than student engagement as a whole (Gillen-O'Neel, 2021; Hopkins et al., 2021). A recent study by Gillen-O'Neel used survey methods to analyze student engagement and sense of belonging among first- and continuing-generation students (2021). Gillen-O'Neel found that sense of belonging can indicate higher levels of engagement reported by students, especially in first-generation college students. This study gives potential insight on why students are

engaging in activities, but not necessarily the activities students are engaging in or how these activities could relate to other aspects of student experiences and academic achievement.

Another study focused on out-of-classroom engagement of first-generation students in relation to persistence (Hopkins et al., 2021). The study used interviews and a focus group to look closer at specific out-of-classroom engagement practices and how they affect students' likeliness to persist. The study found that students perceived that out-of-class engagement helped them to build a foundation to persist (Hopkins et al., 2021). This study, like the Gillen-O'Neel study (2021), potentially sheds light on why students choose to have higher levels of engagement, but also looks at engagement as an indicator and not the focus of the research. Focusing on specific engagement activities of FGC students is the first step to helping promote helpful activities to better aid FGC students.

Studies focusing on first-generation college students in STEM fields focus on STEM and non-STEM differences in engagement and out-of-class activities (Nelson Laird et al., 2011; Simmons & Chau, 2021). Simmons and Chau examined engagement in out of class activities and found that first-generation college students in STEM were less likely than their continuing-generation peers to participate in out of class activities (2021). The study also discussed how first-generation college students in STEM might benefit from out-of-class activities with the proper guidance (Simmons & Chau, 2021). The findings of the study stress the need for more research on student engagement of different groups of first-generation students. First-generation engineering students may be engaging more in activities within the classroom, and research in this area will help us to answer this.

2.4 First-Generation Engineering Students

Studies focusing on first-generation college students in engineering look at different variables related to student engagement. (Boone & Kirn, 2017; Verdín & Godwin, 2015; Verdín & Godwin, 2018). Much of this research focuses on persistence and what factors may lead to first-generation college students in engineering to choose an engineering major and persist to graduation. Common engagement themes included study habits, institutional support, social capital, and influential figures in students' lives (Garriott et al., 2017; Hunt et al., 2018; Martin, 2015; Mobley et al., 2013; Verdín et al., 2018)

A recent qualitative study looking at first-generation engineering students' utilization of social capital described social capital (using Lin's Network Theory of Social capital) as the availability, accessibility, and activation of resources embedded in social networks (Martin, 2015). Lin's theory focuses on social networks at an individual level and acknowledges that with purposeful action from an individual, goals may be reached without a group (Martin, 2015). The study focused on the necessity of FGC engineering students' activation of resources to enroll in engineering degrees. The study utilized interviews and found that this activation was not necessary when resource-rich networks were present for students. The study also found that when FGC engineering students were involved in engineering programs, the people associated with the program elicited more meaning to the first-generation engineering students than the program itself (Martin, 2015). Both in- and out-of-class engagement deal with resources in students' social network. Some examples of these resources might be peers, institutional contacts, or faculty mentors. This thesis research looks at how often these resources are utilized as opposed to the necessity of using them. Findings may add to previous research from the Martin study in 2015 or counter its findings by

showing the relationship between utilization of resources in social networks and academic success for students.

Another qualitative study discussing social capital in first-generation engineering transfer students explored students' study strategies and involvement in extracurricular activities among other factors of the transfer process (Mobley et al., 2013). Students were divided into low, middle, and high parental education groups and the study found that middle and high parental education students were more likely than low parental education students to use personal networks to obtain advice about coursework and success in college. Low parental education students also felt that they were independent and able to figure things out on their own. Where high parental education students sought help from professors, low and middle parental education students sought out tutoring hours and supplemental instruction sessions. Lastly, high parental education students did not take as active a role in extracurricular clubs and organizations as their middle and low parental education counter parts. The high parental education students did join these groups, but did not seek active roles (Mobley et al., 2013). These findings are consistent with similar studies, and the social capital that is discussed is like specific types of student engagement in the proposed research. The thesis research, however, uses quantitative measures and focuses not on social capital or transfer students specifically, but more on holistic engagement.

One major focus of research on first-generation college students overall is persistence. This holds true with research on first-generation college students in engineering as well. One particular study examined parental support and self-efficacy of first-generation college students in engineering and found that self-efficacy was not a predictor of outcome expectations for students (Garriott et al., 2017). Results also showed that parental support

predicted vicarious learning from students. As with many of the previously discussed studies, engagement factors can be related to persistence, however with the lack of present research on engineering engagement as a whole, the thesis research is necessary before any of these larger connections can be explored.

A different study also focusing on persistence researched first-generation engineering students engineering identity, sense of belongingness, and persistence of effort (Verdín et al., 2018). The study found that students' sense of belonging was directly affected by the students' engineering identity or participation "in the engineering community of practice." Both the belongingness and identity components had a positive direct effect on persistence in effort (Verdín et al., 2018). Sense of belonging at an institutional and major specific level is important for students to feel accepted and feel the need to be active in their studies and learning processes. Sense of belonging is also an element that appears in the NSSE questions that the proposed research utilizes. As with much of the research on first-generation engineering students, this study takes a specific element of student engagement and highlights it. The thesis study seeks to highlight student engagement all inclusively, and not just one specific aspect of it.

A recent study also looked at how first-generation engineering students view college as opposed to their second-generation peers (Hunt et al., 2018). It also found that for second-generation college students in engineering, college is more a continuation of their social and cultural lives, and more of a next step in that aspect. For first-generation college students in engineering, participation is more focused on the outcome of the activity and how it will help them (Hunt et al., 2018). This result calls for more research on what specific activities first-generation students in engineering are engaging in. We would expect that first-generation

students would be more engaged in academically focused activities based on this result, but research is needed to confirm this.

2.5 First-Generation Engineering Students and Student Engagement

Research focusing on the engagement of first-generation college students in engineering has taken many different approaches to look at different variables. Different methods are used, and both in and out of classroom engagement are highlighted individually. Some studies pull engagement in as a sub-topic and relate it to other topics (Mazumder et al., 2020; Navarro et al., 2019; Polmear et al., 2021).

One of the more interesting research designs regarding in-class student engagement of engineering students in relation to academic success utilized a mixed methods methodology with observational and self-reporting survey methods (Mazumder et al., 2020). This design placed observers in a classroom and had the observers look for specific student expressions and actions associated with engagement. The study found that there was a weak correlation between student engagement and academic success. And a slightly significant difference between first-generation students and another students' engagement. Both results contradicted the original hypothesis for the research (Mazumder et al., 2020). The contradictory results of the study call for more research to be explored in this area. The thesis study uses a different method to study some of the same core principles, and broaden the data pool by collecting information about out of class engagement as well as in-class engagement.

Another study regarding first-generation college students in engineering looks at the out-of-class engagement of civil engineering students (Polmear et al., 2021). The study does not focus solely on first-generation students, and instead looks at many diverse sub-

populations. The study utilized survey methods and found that first-generation students were significantly different from their continuing-generation counterparts in all attributes except for the "dynamism, agility, resilience, and flexibility" attribute which was counted as one measure. The study also discussed the importance of out of class engagement for first-generation students in regards to building relationships, and finding opportunities and resources (Polmear et al., 2021). Where the Mazumder study focused on in class engagement, this study focuses on out of class engagement and generally finds the same significant difference between first-generation students and their continuing-generation peers. With the thesis research aiming to bring both types of engagement together into one data set, it will allow for analysis of student engagement as a whole. This inclusive picture will then allow researchers to analyze which categories of engagement correlate in terms of both in and out of classroom engagement.

Other studies also use academic engagement as one of many sub-topics to analyze persistence in engineering majors (Navarro et al., 2019). One study in particular used survey methods to find that engineering academic engagement was significantly and positively related to self-efficacy, outcome expectations, interests, and goal progress for minority groups (Navarro et al., 2019). Engineering academic engagement was not, however, significantly related to engineering intended persistence (Navarro et al., 2019). The study did not focus on first-generation students as a minority group, and used engagement as a factor to be compared to other factors.

2.6 Synthesis

Three major themes emerged from this literature view. The first major theme was persistence through a students' desired major to graduation or students' attainment of a

degree (Bettencourt et al., 2020; Dika & D'Amico, 2016; Garriott et al., 2017; Hopkins, 2021; Hunt et al., 2018; Navarro et al., 2019; Shaw & Barbuti, 2010). The second major theme included experiences of first-generation college students before, during, and after college (Bui, 2002; Fernandez et al., 2008; Manzoni & Streib, 2019; Pascarella et al., 2004; Snodgrass Rangel, 2020; Terenzini et al., 1996). The final theme that emerged in the literature review considers access and utilization of social capital specifically in engineering (Martin, 2015; Mobley et al., 2013; Pfirman et al., 2014).

2.6 Summary

The current research focusing on the topic of engagement of first-generation college students in engineering gives many preliminary findings, but also calls for more research in this area. Specifically, more research is needed on the activities FGC students in engineering are engaging in, and how these activities can aid students academically. Current studies use mixed or qualitative methods and often use engagement as an indicator of larger factors. Quantitative research that looks at student engagement as a main topic is needed for populations of first-generation students in engineering majors. As this thesis research begins to look at student engagement, we want to get an idea of what specific activities this population is engaging in, and how those activities relate to students' overall engagement in different areas. This will aid us in looking to future directions and how to help first-generation students succeed.

CHAPTER 3

RESEARCH DESIGN

3.1 Research Approach

This thesis research employs quantitative methods and utilizes a survey for data collection. An initial survey acted as a pre-screening survey with the purpose of obtaining a sample that fits the desired criteria. The primary survey is the NSSE (Indiana University, 2017, 2013; McCormick et al., 2013), which is used for data collection.

The sample for this research was taken from the College of Engineering at Utah State University, and the participants are first-generation students in their sophomore, junior, or senior year of college. This sample serves the purpose of ensuring that the subjects have taken similar courses from the engineering departments, regardless of the specific discipline the student is enrolled in. The pre-screening survey was the main method of sampling, and the target sample was 60 students. Students were offered a gift card as incentive for participating in this research, and received the $15 gift card upon completion of the NSSE.

The pre-screening survey was a short survey administered to all sophomore, junior, and senior level engineering students in Utah State University's College of Engineering. Participation in filling out the pre-survey was voluntary, and students were asked to provide basic details about themselves to determine if they could be included in the target sample. Questions for the pre-screening survey asked for the students' name, status as an under graduate engineering student, generational status, age, and an email to contact them.

When responses were recorded for the pre-screening survey, we resulted in a final sample of 28 first-generation engineering students and reached out to them via email they provided in the pre-screening survey. Initial contact provided an informed consent form for the student to sign in order to participate in the research.

The main survey participants were asked to complete after providing informed consent was the NSSE, with the addition of four demographic information questions at the beginning of the survey, and a question regarding student GPA at the end. The NSSE asks categorized questions about students' engagement levels in and out of the classroom, and provides useful data to be able to compare these categories against each other to see how they correlate.

3.2 IRB Approval

This research was approved by the Utah State University Institutional Review Board (IRB) using the exempt review process. The approved protocol was #12828. The IRB approval letter can be found in Appendix B, which lists Dr. Ning Fang as the Principal Investigator. The author of this thesis is included in the IRB protocol as a graduate student researcher.

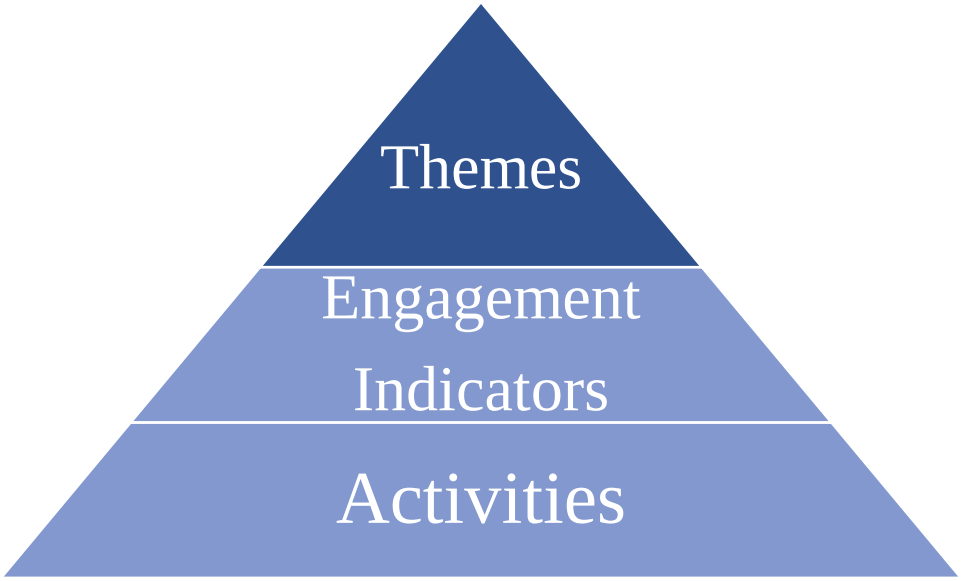
3.3 National Survey of Student Engagement (NSSE)

Data was collected using the National Survey of Student Engagement (NSSE). This survey provides data on various aspects of student engagement such as, classroom engagement, major-related extracurricular activities, and educational experiences. (Indiana University, 2013). The NSSE facilitators identify ten Engagement Indicators within survey items. These indicators contribute to four overall themes that facilitators also identified

(Indiana University, 2021). The engagement indicators are higher-order learning, reflective and integrative learning, learning strategies, quantitative reasoning, collaborative learning, discussions with diverse others, student-faculty interaction, effective teaching practices, quality of interactions, and supportive environment. The themes are academic challenge, learning with peers, experiences with faculty, and campus environments. We used these indicators to calculate an overall engagement score for each respondent. Each item was coded using a 60-point scale, and points were evenly distributed for each response. For example, for a question having answer choices of *Never, Sometimes, Most of the Time*, and *Always*, never could be scored as 0 and always would be coded as 60. Each survey item carried a score out of 60, and then survey items contributing to specific engagement indicators were averaged. These averages were the scores for the engagement indicators. Engagement indicator scores contributing to a specific theme were then averaged, and these became the overall theme scores. The survey items that contributed to each indicator and the indicators that contributed to each theme were determined by the NSSE and are shown in Table 1. Survey items from Table 1 are shown in Appendix A. Figure 1 shows how engagement activities, indicators and themes are related. Survey items in the NSSE listed specific activities students may engage in.

Figure 1:

Relationship Between Themes, EIs, and Activities



The choice to utilize the NSSE also lies in the survey's versatility in measuring many factors of student engagement, and its generalizability to larger groups. A recent study found that the means produced from the NSSE measures in research using small samples can be generalized to larger populations at post-secondary institutions (Fosnacht & Gonyea, 2018). With a sample size of 28 students for this research, the generalizability to larger populations was a deciding factor in using the NSSE as the main survey instrument. Other survey tools used to measure aspects of STEM student engagement include items regarding multiple subjects, do not include both out of class and in classroom engagement items, or are broader, focusing on engagement along with other factors (Leibowitz, 2020; Caspersen, & Smeby, 2018). Use of the NSSE ensures that results included topics of both in and out of classroom engagement.

In general, there are fewer first-generation college (FGC) students than their continuing-generation college (CGC) counterparts. This number becomes even smaller in

more difficult majors such as engineering. Because of this fact, this thesis research targets a smaller sample of 28 subjects. The subjects are sophomore, junior, and senior year students from the College of Engineering at Utah State University. The NSSE is generalizable for students of any class level, so the utilization of sophomore, junior, and senior students is acceptable (Fosnacht & Gonyea, 2018). Using these class levels also ensures that students will have had the opportunity to choose the types of engagement they participate in. For example, a freshman student may be looking to create a study group for their engineering classes but has not yet had the opportunity or taken the classes where it is relevant to do so.

Table 1

Themes, Engagement Indicators, and Survey Items

Theme	Engagement Indicator	Survey Item
Academic Challenge	Higher-Order Learning	HOL: 4b, 4c, 4d, 4e
	Reflective and Integrative Learning	RIL: 2a, 2b, 2c, 2d, 2e, 2f, 2g
	Learning Strategies	LS: 8a, 8b, 8c
	Quantitative Reasoning	QR: 6a, 6b, 6c
Learning with Peers	Collaborative Learning	CL: 1b, 1c, 1d, 1e
	Discussions with Diverse Others	DDO: 7a, 7b, 7c, 7d
Experiences with Faculty	Student-Faculty Interaction	SFI: 3a, 3b, 3c, 3d
	Effective Teaching Practices	ETP: 5a, 5b, 5c, 5d, 5e
Campus Environment	Quality of Interactions	QI: 9a, 9b, 9c, 9d, 9e
	Supportive Environment	SE: 10b, 10c, 10d, 10e, 10f, 10g, 10h, 10i

3.3.1 Academic Challenge

This theme relates to students' engagement experience by measuring engagement in academic activities centered around students' courses. The EIs for this theme are higher-order learning, reflective and integrative learning, learning strategies, and quantitative reasoning.

Example 1: During the current school year, about how often have you done the following? *Response options: Very Often, Often, Sometimes, Never*

a. Reached conclusions based on your own analysis of numerical information (numbers, graphs, statistics, etc.)
b. Used numerical information to examine a real-world problem or issue (unemployment, climate change, public health, etc.)
c. Evaluated what others have concluded from numerical information

3.3.2 Learning with Peers

This theme relates to students' experiences with peers in terms of working together on coursework and overall interactions with students from backgrounds different from their own. The EIs relating to this theme are collaborative learning and discussions with diverse others.

Example 2: During the current school year, about how often have you had discussions with people from the following groups? *Response options: Very often, Often, Sometimes, Never*

a. People of a race or ethnicity other than your own
b. People from an economic background other than your own

c. People with religious beliefs other than your own

d. People with political views other than your own

3.3.3 Experiences with Faculty

This theme relates to students' interactions with faculty at their institution. Interactions may take place in class and be related to coursework, or take place out of class and be related to other educational matters.

Example 3: During the current school year, to what extent have your instructors done the following? *Response options: Very much, Quite a bit, Some, Very little*

a. Clearly explained course goals and requirements

b. Taught course sessions in an organized way

c. Used examples or illustrations to explain difficult points

d. Provided feedback on a draft or work in progress

e. Provided prompt and detailed feedback on tests or completed assignments

3.3.4 Campus Environment

This theme focuses on the overall experience students' have with their institution. It relates to the resources available to students and that institutions emphasize, and students' utilization of these resources. The EIs relating to this theme are quality of interactions and supportive environment.

Example 4: How much does your institution emphasize the following? *Response options: Very much, Quite a bit, Some, Very little*

a. (Not included in engagement indicator) Spending significant amounts of time studying and on academic work

b. Providing support to help students succeed academically

c. Using learning support services (tutoring services, writing center, etc.)

d. Encouraging contact among students from different backgrounds (social, racial/ethnic, religious, etc.)

e. Providing opportunities to be involved socially

f. Providing support for your overall well-being (recreation, health care, counseling, etc.)

g. Helping you manage your non-academic responsibilities (work, family, etc.)

h. Attending campus activities and events (performing arts, athletic events, etc.)

i. Attending events that address important social, economic, or political issues

These sample questions give a good idea of the wide range of student engagement topics the NSSE covers, and the type of data it provides. As it was summarized in the Literature Review, student engagement is comprised of many categories and most studies only focus on a few select pieces. The NSSE is an exhaustive survey and covers all known areas of engagement as opposed to a select few, in order to give the most complete and generalized conclusions possible.

3.4 Population and Sampling

The population for this research is first-generation college students in engineering majors. Preliminary sampling for this research was completed using a screening survey. The sample is taken from undergraduate sophomore, junior, and senior level engineering students

studying engineering at Utah State University because it is likely that students in these years will have taken engineering specific courses. Students fitting these criteria received an email to their preferred student email addresses, inviting them to complete a screening survey. The screening survey asked students their degree category, class level, first-generation student status, and demographic information for following up with potential participants. This survey produced 42 potential participants. After completing the screening survey, eligible participants were sent a copy of the informed consent form to look over and sign if they chose to participate. Of the original 42 respondents, 30 provided their informed consent to participate in the data collection survey. These 30 were sent a personal copy of the informed consent form and a link to the main data collection survey. The data collection survey yielded 28 responses.

A sample size calculation was completed using equation 1. In equation 1, C relates to the expected correlation coefficient, r. The equation for C is shown in equation 2. Values of alpha and beta used for Z values in equation 1 were chosen to be 0.01 and 0.2. The value for r was chosen to be 0.6. These calculations were completed in Excel ® and verified that 28 participants were sufficient (Mondal & Mondal, 2016).

$$N = \left[\frac{Z_{\propto} + Z_{\beta}}{C}\right]^2 + 3 \quad (1)$$

$$C = 0.5 * \ln\left[\frac{(1+r)}{(1-r)}\right] \quad (2)$$

3.5 Context

Data collection for this study took place in the summer months when many students were away from campus. Invitation to participate emails were sent to students' school email addresses, which students may or may not check regularly during this time frame. We believe

that this may have been a factor in the response rate of the pre-screening survey. In addition to this, many students who are in school right now have been affected by the COVID-19 pandemic in some way. Students reported engagement may reflect this, and this factor alone may change what activities students were able to engage in.

3.6 Participants

The sample for this survey was 28 first-generation college students enrolled in the College of Engineering at Utah State University. Of these 28 participants, 28.6% were sophomores, 39.3% were juniors, and 32.1% were seniors. In terms of participant age, 25% were 18-20 years old, 50% were 21-23 years old, 17.9% were 24-26 years old, and 7.1% were more than 28 years old. In regards to major, the sample included 10 participants in mechanical engineering, 7 participants in aerospace engineering, 4 participants in civil engineering, 3 participants in environmental engineering, 2 participants in computer engineering, 1 participant in biological engineering, and 1 participant in electrical engineering. Of the 28 participants, 10 identified as female, 17 identified as male, and 1 did not identify.

3.7 Data Analysis

The data for this research was analyzed using a correlational analysis via SPSS, following the prior work done by Fang (2021). This research aims to obtain an initial picture of student engagement by looking at relationships between engagement indicators and themes, so correlational analysis was the type of analysis chosen for this study. The data presented both normal and non-normal distributions for different variables, so both parametric and non-parametric results are shown. Normality was determined by analyzing

the Q-Q plots of the data and using a Shapiro-Wilk test to test normality. Depending on the normality of the variable, either Pearson or Spearman correlations were completed.

CHAPTER 4

RESULTS

4.1 Normality Tests

After initial organization of the data, normality tests were completed for each engagement indicator and each theme and participant GPA. Combined there were 15 total variables that underwent a Shapiro-Wilk normality test. Table 3 shows the results of this test. Variables that tested to be non-normal are denoted with an asterisk (*). As an example of variable distribution, Figure 1 shows the Q-Q plot for the normally distributed variable Reflective and Integrative Learning engagement indicator (RIL_T) while Fig. 2 shows the histogram. A Q_Q plot showing normally distributed data will have data points on or around the line shown on the Q_Q plot. A histogram showing normally distributed data will have a bell curve shaped distribution. For reference, Table 2 shows the name of each variable. In Table 2, Themes are listed, and EIs contributing to each specific theme follow the theme.

Table 2

Variable Names

Variable	Name	Type
AC	Academic Challenge	Theme
HOL	Higher-Order Learning	EI
RIL	Reflective and Integrative Learning	EI
LES	Learning Strategies	EI
QUR	Quantitative Reasoning	EI
LP	Learning with Peers	Theme
COL	Collaborative Learning	EI
DDO	Discussions with Diverse Others	EI
EF	Experiences with Faculty	Theme
SFI	Student-Faculty Interaction	EI
ETP	Effective Teaching Practices	EI
CE	Campus Environment	Theme
QOI	Quality of Interactions	EI
SPE	Supportive Environment	EI

Table 3

Shapiro-Wilk Normality Test

Variable	Significance
HOL_T	0.103
RIL_T	0.753
LES_T*	0.024*
QUR_T	0.090
COL_T	0.097
DDO_T*	0.033*
SFI_T*	0.002*
ETP_T	0.266
QOI_T	0.117
SPE_T*	0.014*
AC_T	0.329
LP_T	0.135
EF_T	0.205
CE_T	0.293
GPA*	<0.001*

* Denotes a non-normal distribution

Figure 2

Q_Q Plot of Reflective and Integrative Learning Engagement Indicator

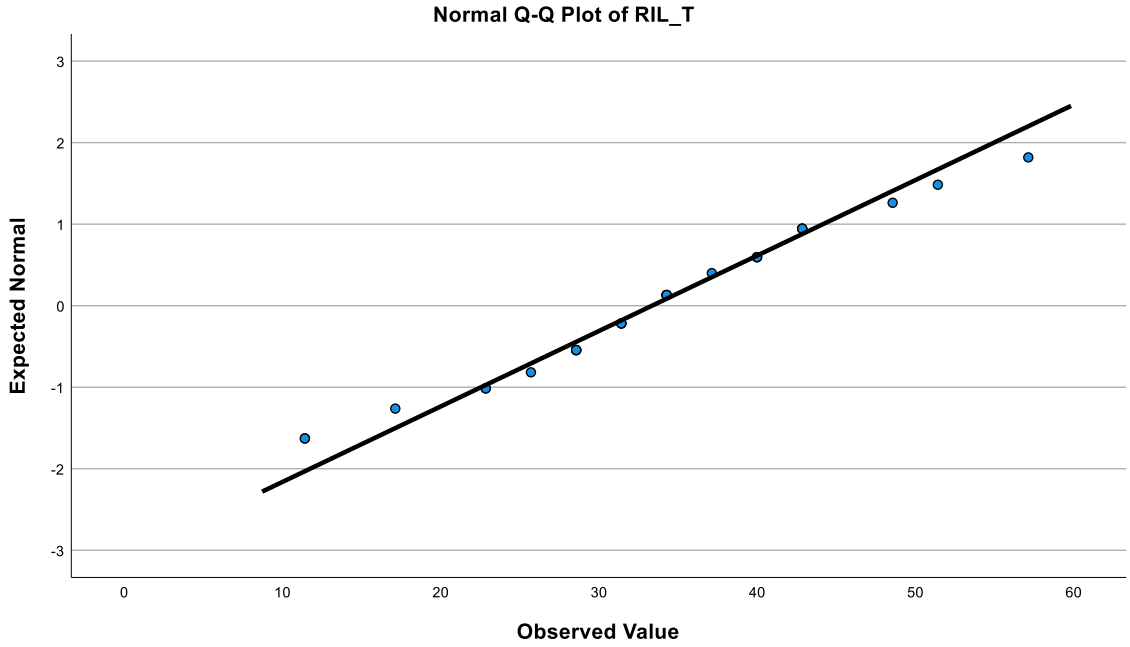
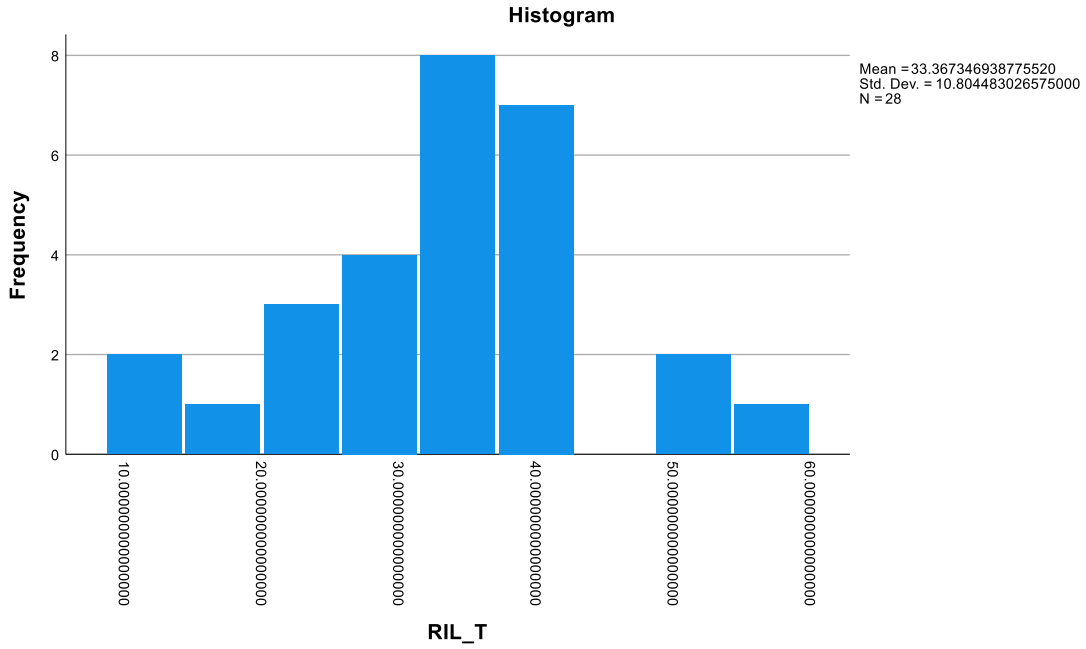


Figure 3

Histogram Showing Distribution of Reflective and Integrative Learning Engagement Indicator



The Student-Faculty Interaction engagement indicator (SFI_T) tested to be a non-normal distribution. The Q_Q plot for the student-faculty interaction engagement indicator is shown in Figure 3. Figure 4 shows the distribution of the Student-Faculty Interactions (SFI_T) engagement indicator; the distribution shown is a non-normal distribution. From the Shapiro-Wilk results, along with Figures 3 and 4, we can see the non-normal distribution in the SFI_T variable and how it differs from the normal distribution. Figures 5-30 show Q-Q plots and histograms for all remaining variables and can be found in Appendix C.

Figure 4

Q_Q Plot of Student-Faculty Interaction Engagement Indicator

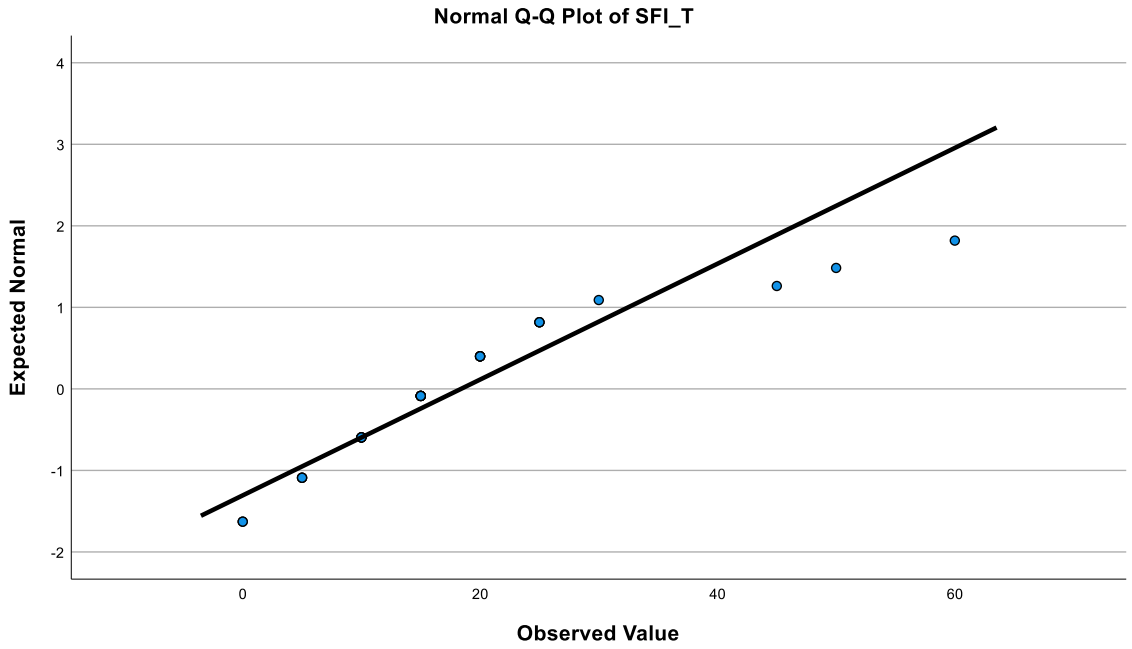
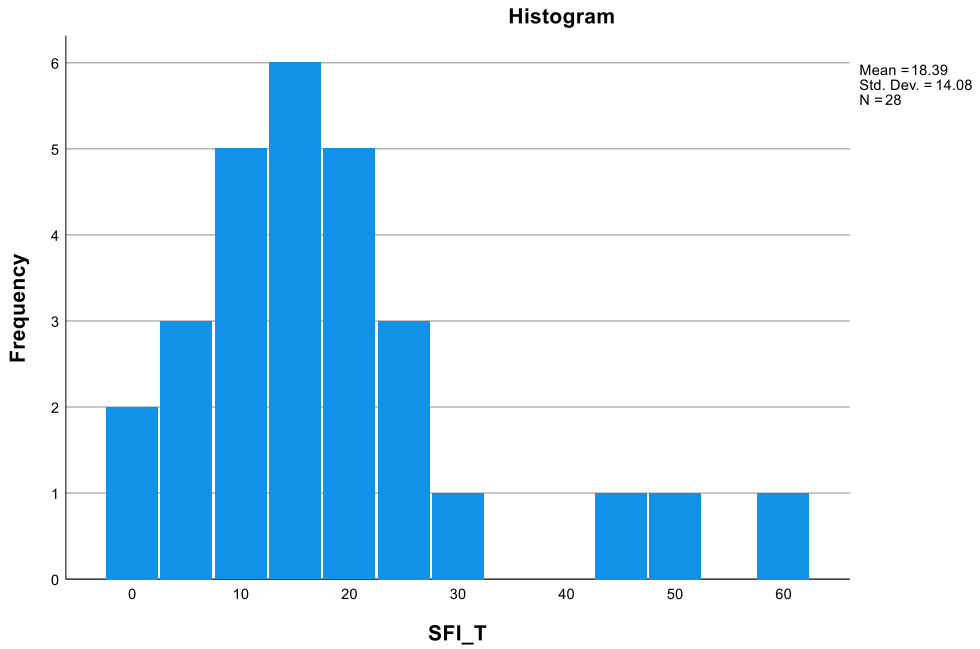


Figure 5

Histogram Showing Distribution of the Student-Faculty Interactions Engagement Indicator



4.2 Research Question 1: What is the engagement experience for first-generation college students in engineering at Utah State University?

To look at the participant engagement experience, we produced descriptive statistics for each engagement indicator and each resulting theme. For each engagement indicator or theme, the maximum score a participant could produce is 60, which represents a reported maximum possible engagement on all of the items. Mean scores and standard deviations for the engagement indicators and themes are shown in Table 4. For the engagement indicators, the highest mean score was learning strategies (42.86) and the lowest was student-faculty interaction (18.39). For the themes the highest mean score was in learning with peers (37.05), and the lowest was experiences with faculty (27.55).

Table 4

Mean Scores and Standard Deviations for Engagement Indicators and Themes

	Variable	Mean	Standard Deviation
Engagement Indicators			
	HOL_T	38.93	12.50
	RIL_T	33.37	10.80
	LES_T	42.86	12.50
	QUR_T	32.14	12.70
	COL_T	35.00	15.81
	DDO_T	39.11	10.46
	SFI_T	18.39	14.08
	ETP_T	36.71	9.86
	QOI_T	37.86	11.49
	SPE_T	30.18	11.51
Themes			
	AC_T	36.82	9.17
	LP_T	37.05	8.69
	EF_T	27.55	7.94
	CE_T	34.02	9.98
GPA	GPA	3.60	0.45

4.3 Research Question 2: Do different categories of engagement correlate to one another for first-generation college students in engineering? If so, how?

Correlational analysis showed the relationship between themes and between engagement indicators. All the themes were normally distributed, which allowed for Pearson correlations to be used. Pearson correlations between themes are shown in Table 5. For the engagement indicators, six of the variables are normally distributed and four are non-normally distributed. Because of this result, Spearman (for non-parametric analysis) or Pearson (for parametric analysis) correlations were computed based on the distribution present. Any correlation involving the learning strategies, discussions with diverse others, student faculty, or supportive environment variables (LES, DDO, SFI, SPE) is a Spearman

correlation, and all Spearman correlations are listed in bold. Correlations are shown in Table 6.

Table 5

Pearson Correlations Between Themes

	AC_T	LP_T	EF_T	CE_T
AC_T	1.000	0.182	0.687**	0.626**
LP_T		1.000	0.229	0.041
EF_T			1.000	0.690**
CE_T				1.000

**Correlation is significant at the 0.01 level

Table 6

Correlations for Engagement Indicators

Correlation Type		HOL_T	RIL_T	LES_T	QUR_T	COL_T	DDO_T	SFI_T	ETP_T	QOI_T	SPE_T
Pearson	HOL_T	1.000	0.576**	**0.499****	0.388*	-0.028	**0.147**	**0.195**	0.728**	0.342	**0.693****
Pearson	RIL_T		1.000	**0.489****	0.495**	0.235	**0.125**	**0.370**	0.443*	0.295	**0.430***
Spearman	LES_T			1.000	**0.048**	**0.029**	**0.101**	**0.273**	**0.474***	**0.419***	**0.423***
Pearson	QUR_T				1.000	0.184	**-0.047**	**0.533****	0.149	0.313	**0.340**
Pearson	COL_T					1.000	**-0.113**	**0.461***	-0.333	-0.024	**0.049**
Spearman	DDO_T						1.000	**-0.103**	**0.128**	**-0.198**	**0.058**
Spearman	SFI_T							1.000	**-0.101**	**0.415***	**0.376***
Pearson	ETP_T								1.000	0.432*	**0.422***
Pearson	QOI_T									1.000	**0.483****
Spearman	SPE_T										1.000

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

4.4 Research Question 3: Does engagement experience relate to student GPA for first-generation college students in engineering at Utah State University? If so, how?

Correlational analysis shows the relationship between student GPA and engagement indicators and themes. Because student GPA was a non-normally distributed variable, a

Spearman correlation was used for this research question. Results of the Spearman Correlation between GPA and themes are shown in Table 7. Results of the Spearman Correlation between GPA and engagement indicators are shown in Table 8.

Table 7

Spearman Correlations Between GPA and Themes

	GPA	AC_T	LP_T	EF_T	CE_T
GPA	1.000	0.199	0.038	0.130	0.297
AC_T		1.000	0.191	0.704**	0.563**
LP_T			1.000	0.189	-0.015
EF_T				1.000	0.656**
CE_T					1.000

** Correlation is significant at the 0.01 level

Table 8

Spearman Correlations Between GPA and Engagement Indicators

	HOL_T	RIL_T	LES_T	QUR_T	COL_T	DDO_T	SFI_T	ETP_T	QOI_T	SPE_T	GPA
HOL_T	1.000										
RIL_T		1.000									
LES_T			1.000								
QUR_T				1.000							
COL_T					1.000						
DDO_T						1.000					
SFI_T							1.000				
ETP_T								1.000			
QOI_T									1.000		
SPE_T										1.000	
GPA	0.298	0.120	0.133	0.064	0.297	-0.271	0.141	0.006	0.183	0.414*	1.000

* Correlation is significant at the 0.05 level

CHAPTER 5

DISCUSSION

5.1 Engagement Experience

In terms of overall engagement based on the engagement indicators and themes, first-generation college students in engineering at Utah State University had the highest mean score of 42.86 in the learning strategy engagement indicator and the highest mean score of 37.05 in the learning with peers theme. As shown in Table 3, many of the mean scores for the engagement indicators range from 30-39 with one score being in the 40s and the lowest mean of 18.39 in the student-faculty interaction engagement indicator. The lowest theme mean score of 27.55 was in the experiences with faculty theme.

Activities that contribute to the learning with peers theme relate to students working with others on course work, on understanding course material, on exams and projects, and on studying for exams. The high mean score in this theme indicates that FGC students in engineering are seeking out peers to work with, and creating relationships and networks with peers often.

Activities that contribute to the learning strategy engagement indicator are identifying key information from reading assignments, reviewing notes after class, and summarizing learning from class or course materials. The high mean score in this engagement indicator indicates higher levels of student engagement in these activities. Activities that contribute to the student-faculty interaction engagement indicator are students talking about career plans with faculty members, working with faculty members on activities other than coursework, discussing course topics, ideas, or concepts with faculty members outside of class, and

discussing academic performance with faculty members. The lower mean score in this engagement indicator indicates lower levels of engagement with these activities. This lower mean could potentially be from students taking classes amidst the COVID-19 pandemic when education was primarily online. Many of the activities that contribute to this indicator often happen in person, and if students were taking courses remotely, they may not have had the opportunity to engage in these activities. Another factor that could potentially have an impact on students' interactions with faculty is FGC students feeling apprehensive about having these discussions. To some degree, every college student feels apprehensive about visiting a professor's office or approaching professors about questions. It is possible that students' FGC status may heighten this feeling even more.

5.2 Correlations Between Themes

Looking at the different themes of student engagement, this thesis study found significant correlations between 3 of the 4 themes. All correlations were Pearson correlations significant at the 0.01 level. A positive correlation of 0.687 was found between the academic challenge and experiences with faculty themes. A positive correlation of 0.626 was also found between the academic challenge and campus environment themes. Lastly, a positive correlation of 0.690 was found between the experiences with faculty and campus environment themes.

These three positive correlations indicate positive relationships among themes. It is fair to say that with more academic challenges, students may look to heighten their engagement with faculty and campus resources in order to succeed. This appears to be true for first-generation college students in engineering at Utah State University as well.

5.3 Correlations Between Engagement Indicators

There were many significant positive correlations among engagement indicators. Correlational analysis showed 8 positive Spearman correlations significant at the 0.05 level, and 5 positive Spearman correlations significant at the 0.01 level. Analysis also showed 3 positive Pearson correlations significant at the 0.05 level and 3 Pearson correlations significant at the 0.01 level. For convenience, significant correlations appear in Table 9.

Table 9

Significant Correlations

Variables	Value	Significance	Type
COL, SFI	0.461	0.05	Spearman
LES, ETP	0.474	0.05	Spearman
LES, QOI	0.419	0.05	Spearman
SFI, QOI	0.415	0.05	Spearman
RIL, SPE	0.430	0.05	Spearman
LES, SPE	0.423	0.05	Spearman
SFI, SPE	0.376	0.05	Spearman
ETP, SPE	0.422	0.05	Spearman
QUR, SFI	0.533	0.01	Spearman
HOL, LES	0.499	0.01	Spearman
RIL, LES	0.489	0.01	Spearman
HOL, SPE	0.693	0.01	Spearman
QOI, SPE	0.483	0.01	Spearman
RIL, ETP	0.443	0.05	Pearson
ETP, QOI	0.432	0.05	Pearson
HOL, QUR	0.388	0.05	Pearson
HOL, RIL	0.576	0.01	Pearson
RIL, QUR	0.495	0.01	Pearson
HOL, ETP	0.728	0.01	Pearson

Of the significant correlations found, two proved to be the strongest correlations. A Pearson correlation of 0.728 was found between higher-order learning and effective teaching practices. A Spearman correlation of 0.693 was found between higher-order learning and supportive environment. Both of the above correlations were significant at the 0.01 level. The significant positive correlations indicate that higher participation in one engagement

indicator relates to higher participation in the other engagement indicator it is positively correlated with. The collaborative learning and discussions with diverse others engagement indicators had little to no significant correlations between themselves or other variables. This could be due to students not participating in these activities at all, or participation in these activities not relating to participation in the other engagement indicators.

5.4 Engagement Experience and GPA

Of all the student engagement indicators and themes, only one engagement indicator showed a significant positive spearman correlation with student GPA for first-generation college students in engineering at Utah State University. The supportive environment engagement indicator showed a positive correlation of 0.414, that was significant at the 0.05 level. Activities included in the supportive environment engagement indicator have to do with institutions emphasizing different social contact and providing support to students in various areas. This indicates that more support and social contact relates to higher student GPA for first-generation college students in engineering at Utah State University.

5.5 Limitations of this Thesis Research

The main limitation of this thesis research is the lack of diversity in the sample itself. Of the 28 participants, there were no international students present in the sample. Where this research is focused on students' first-generation college status and not on students' nationality, this did not detract from the overall findings. A more diverse sample however may give even more insight into different engagement activities among first-generation college students in engineering.

The second limitation of this research is that students' engagement in activities may have been affected by the COVID-19 pandemic. Some activities may not have been available

for students to engage in, and some activities may have looked different during and immediately following the COVID-19 pandemic.

CHAPTER 6

CONCLUSIONS

6.1 Conclusions

This research looked to create an initial picture of student engagement for first-generation college students in engineering majors at Utah State University. Findings show that students engaged the most in the learning strategies engagement indicator and learning with peers theme. Many different themes and engagement indicators positively correlated to one another in a correlational analysis using both Spearman and Pearson correlations. There were 19 significant positive correlations between engagement indicators, and significant positive correlations between the academic challenge, experiences with faculty, and campus environment themes. In terms of correlation with student GPA, students having a supportive environment at their institution positively correlated to student GPA with a correlation of 0.414.

The significant positive correlation of 0.693 between supportive environment and higher-order learning supports findings from a study by Gillen-O'Neel in 2021. This study found that sense of belonging can indicate higher levels of engagement reported by students, especially in first-generation college students (Gillen-O'Neel, 2021). Where the Gillen-O'Neel study focused on FGC students irrespective of major, our study sees similar results with FGC students in engineering. Sense of belonging and supportive environment are similar variables, and both show a relationship with higher levels of engagement. Our result adds to the literature in this area by looking deeper into the engagement activities that heighten with a more supportive environment.

A significant positive correlation between student GPA and the supportive environment engagement indicator agrees with findings from a similar study completed by Mazumder et al. in 2021. This study found a weak correlation between student engagement and academic success. (Mazumder et al., 2020). Our study found a moderate correlation between a measurable level of academic success and a specific category of student engagement. The Mazumder study called for more research in this area, and our study helps to fill this need with results that are consistent with the findings from other studies similar to ours (i.e., the Mazumder study).

The significant positive correlations from this research give an idea of what engagement activities first-generation college students in engineering are seeking. FGC students in engineering value learning with peers, and seek a supportive environment and effective teaching practices when higher levels of higher order learning are taking place, as is common in engineering majors. Support in these categories can come from learning services (tutoring, writing centers), opportunities and events that encourage students to be involved socially, and helping students with non-academic issues. Support from faculty and staff comes from encouraging educational discussions and academic activities with students relating to topics outside of classroom work, as well as providing feedback, examples, and clear goals and objectives for students in the classroom.

Overall, this research provides a picture of student engagement among first-generation students in engineering majors at Utah State University. This picture is the foundation to helping bridge the gaps present between first- and continuing-generation students (Bettencourt et al, 2020; Garriott & Nisle, 2018 Pike & Kuh, 2005; Shaw & Barbuti, 2010). By knowing the engagement of first-generation students and what activities they are

engaging in that correlate to GPA, we can help promote this engagement to future first-generation students in engineering, and provide the students with tools to be successful.

6.2 Implications

This research has implications for first-generation students in engineering majors. By knowing more about engagement activities for this group of students and how those activities relate to academic success, students can look to create and facilitate more opportunities for engagement. Students can look to seek out a supportive campus environment and peers to support learning; educators and institutions can look to help create this environment for students. These practices in turn will help to create a better experience for first-generation students in engineering majors.

The correlations between higher-order learning and effective teaching practices as well as higher order learning and supportive environment have further implications for educators and institutions supporting FGC students in engineering. In majors like engineering where higher-order learning is common, educators can look to employ effective teaching practices to support this type of cognitive activity. These activities could be using relevant examples, and providing clear and detailed feedback to students. Institutions can also look to support higher-order learning by emphasizing resources to students. These resources could be places for students to be involved socially, or academic resources such as tutoring centers. The correlation between supportive environment and student GPA further supports the need for institutions to emphasize these resources to FGC students in engineering.

6.3 Future Work

Future research in this area could add a qualitative element with student interviews or compare first-generation students' engagement with their continuing generation counterparts.

A qualitative study may seek out participants of the current study and interview them to further understand their engagement practices. Adding this element to this research in the future could help us to understand more of why students are engaging in the activities they are, and if they feel those activities are especially helpful to them as first-generation students in engineering.

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APPENDICES

Appendix A: Selected Items from The National Survey of Student Engagement

1. During the current school year, about how often have you done the following? *Response options: Very Often, Often, Sometimes, Never*
    a. (Not included in engagement indicator) Asked questions or contributed to course discussions in other ways
    b. Asked another student to help you understand course material
    c. Explained course material to one or more students
    d. Prepared for exams by discussing or working through course material with other students
    e. Worked with other students on course projects or assignments
    f. (Not included in engagement indicator) Given a course presentation
2. During the current school year, about how often have you done the following? *Response options: Very Often, Often, Sometimes, Never*
    a. Combined ideas from different courses when completing assignments
    b. Connected your learning to societal problems or issues
    c. Included diverse perspectives (political, religious, racial/ethnic, gender, etc.) in course discussions or assignments
    d. Examined the strengths and weaknesses of your own views on a topic or issue
    e. Tried to better understand someone else's views by imagining how an issue looks from their perspective
    f. Learned something that changed the way you understand an issue or concept
    g. Connected ideas from your courses to your prior experiences and knowledge
3. During the current school year, about how often have you done the following? *Response options: Very Often, Often, Sometimes, Never*
    a. Talked about career plans with a faculty member
    b. Worked with a faculty member on activities other than coursework (committees, student groups, etc.)
    c. Discussed course topics, ideas, or concepts with a faculty member outside of class
    d. Discussed your academic performance with a faculty member
4. During the current school year, how much has your coursework emphasized the following? *Response options: Very much, Quite a bit, Some, Very Little*
    a. (Not included in engagement indicator) Memorizing course material
    b. Applying facts, theories, or methods to practical problems or new situations
    c. Analyzing an idea, experience, or line of reasoning in depth by examining its parts
    d. Evaluating a point of view, decision, or information source
    e. Forming a new idea or understanding from various pieces of information
5. During the current school year, to what extent have your instructors done the following? *Response options: Very much, Quite a bit, Some, Very little*
    a. Clearly explained course goals and requirements
    b. Taught course sessions in an organized way
    c. Used examples or illustrations to explain difficult points
    d. Provided feedback on a draft or work in progress
    e. Provided prompt and detailed feedback on tests or completed assignments

   f. (Not included in engagement indicator) Explained in advance the criteria for successfully completing your assignments
   g. (Not included in engagement indicator) Reviewed and summarized key ideas or concepts
   h. (Not included in engagement indicator) Taught in a way that aligns with how you prefer to learn
   i. (Not included in engagement indicator) Enabled you to demonstrate your learning through quizzes, assignments, and other activities
6. During the current school year, about how often have you done the following? *Response options: Very Often, Often, Sometimes, Never*
   a. Reached conclusions based on your own analysis of numerical information (numbers, graphs, statistics, etc.)
   b. Used numerical information to examine a real-world problem or issue (unemployment, climate change, public health, etc.)
   c. Evaluated what others have concluded from numerical information
7. During the current school year, about how often have you had discussions with people from the following groups? *Response options: Very often, Often, Sometimes, Never*
   a. People of a race or ethnicity other than your own
   b. People from an economic background other than your own
   c. People with religious beliefs other than your own
   d. People with political views other than your own
8. During the current school year, about how often have you done the following? *Response options: Very Often, Often, Sometimes, Never*
   a. Identified key information from reading assignments
   b. Reviewed your notes after class
   c. Summarized what you learned in class or from course materials
9. Indicate the quality of your interactions with the following people at your institution. *Response options: 1= Poor to 7 = Excellent, Not Applicable*
   a. Students
   b. Academic advisors
   c. Faculty
   d. Student services staff (career services, student activities, housing, etc.)
   e. Other administrative staff and offices (registrar, financial aid, etc.)
10. How much does your institution emphasize the following? *Response options: Very much, Quite a bit, Some, Very little*
   a. (Not included in engagement indicator) Spending significant amounts of time studying and on academic work
   b. Providing support to help students succeed academically
   c. Using learning support services (tutoring services, writing center, etc.)
   d. Encouraging contact among students from different backgrounds (social, racial/ethnic, religious, etc.)
   e. Providing opportunities to be involved socially

f. Providing support for your overall well-being (recreation, health care, counseling, etc.)
g. Helping you manage your non-academic responsibilities (work, family, etc.)
h. Attending campus activities and events (performing arts, athletic events, etc.)
i. Attending events that address important social, economic, or political issues

Appendix B: IRB Approval Letter

Research
UtahStateUniversity

Institutional Review Board

Exemption #2
Certificate of Exemption

From: Melanie Domenech Rodriguez, IRB Chair

Nicole Vouvalis, IRB Director

To: ***Ning Fang***

Date: ***May 23, 2022***

Protocol #: ***12828***

Title: ***A questionnaire survey of student engagement among first-generation college students in engineering***

The Institutional Review Board has determined that the above-referenced study is exempt from review under federal guidelines 45 CFR Part 46.104(d) category #2:

> *Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met: (i) The information obtained is recorded in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subject; (ii) Any disclosure of the responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation, or (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and the IRB conducts a limited IRB review to make required determinations.*

This exemption is valid for five years from the date of this correspondence, after which the study will be closed. If the research will extend beyond five years, it is your responsibility as the Principal Investigator to notify the IRB **before** the study's expiration date and submit a new application to continue the research. Research activities that continue beyond the expiration date without new certification of exempt status will be in violation of those federal guidelines which permit the exempt status.

If this project involves Non-USU personnel, they may not begin work on it (regardless of the approval status at USU) until a Reliance Agreement, External Research Agreement, or separate protocol review has been completed with the appropriate external entity. Many schools will not engage in a Reliance Agreement for Exempt protocols, so the research team must determine what the appropriate approval mechanism is for their Non-USU colleagues. As part of the IRB's quality assurance procedures, this research may be randomly selected for audit during the five-year period of exemption. If so, you will receive a request for completion of an Audit Report form during the month of the anniversary date of this certification.

In all cases, it is your responsibility to notify the IRB **prior** to making any changes to the study by submitting an Amendment request. This will document whether or not the study still meets the requirements for exempt status under federal regulations.

Upon receipt of this memo, you may begin your research. If you have questions, please call the IRB office at (435) 797-1821 or email to irb@usu.edu.

The IRB wishes you success with your research.

Appendix C: Q-Q Plots and Histograms for Engagement Indicators, Themes, and GPA

Figure C.1

Q_Q Plot of GPA

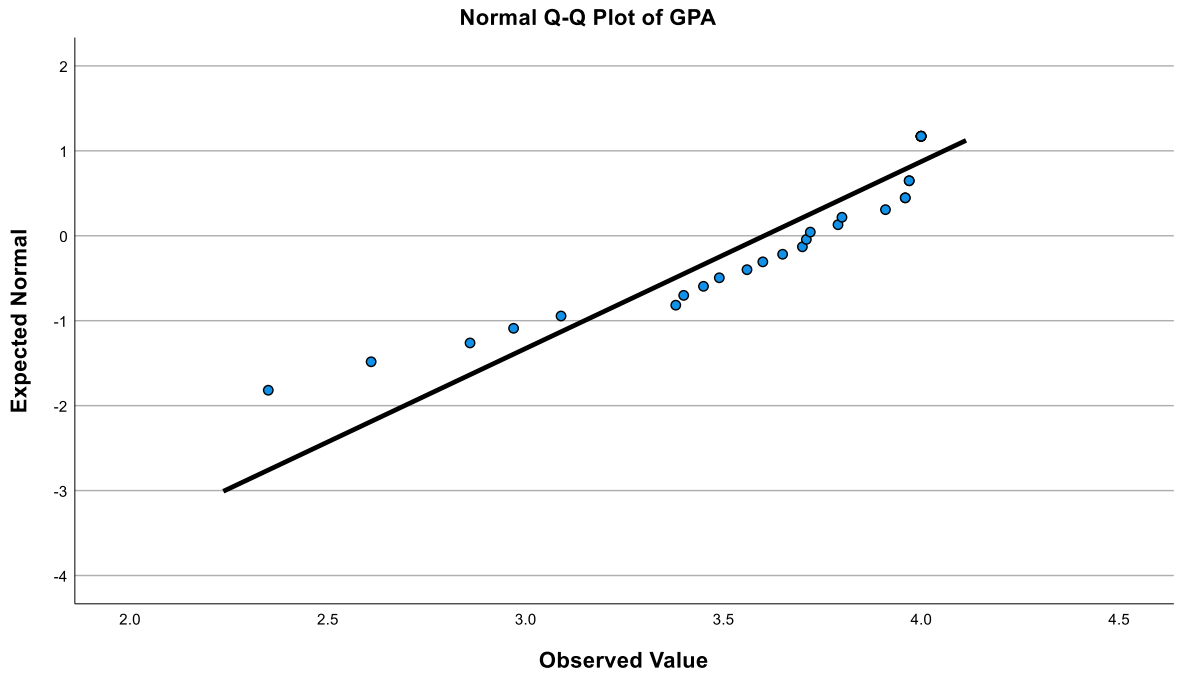


Figure C.2

Histogram Showing Distribution of GPA

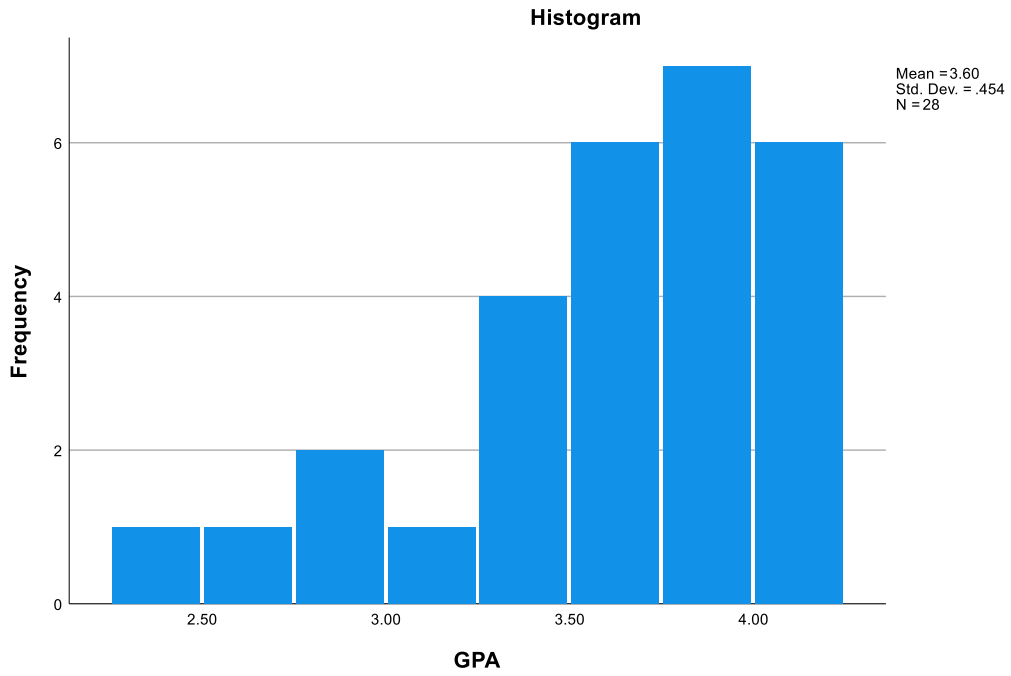


Figure C.3

Q_Q Plot of Higher-Order Learning Engagement Indicator

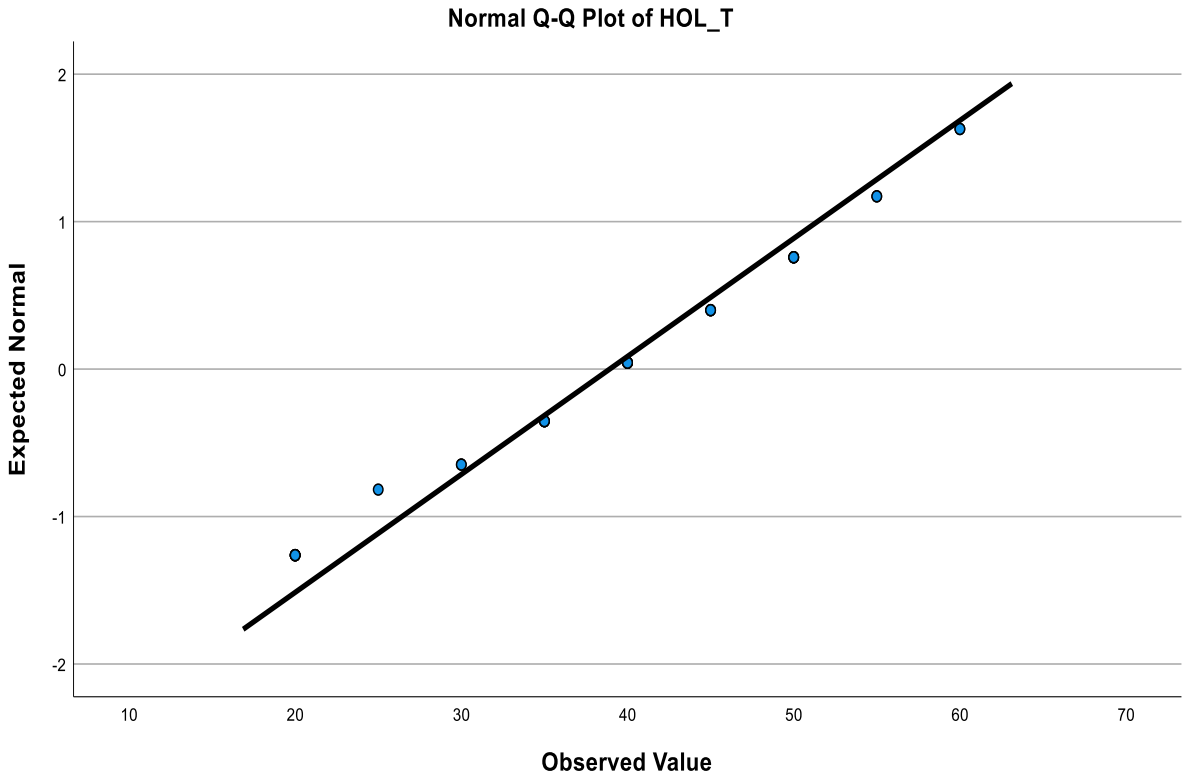


Figure C.4

Histogram Showing Distribution of Higher-Order Learning Engagement Indicator

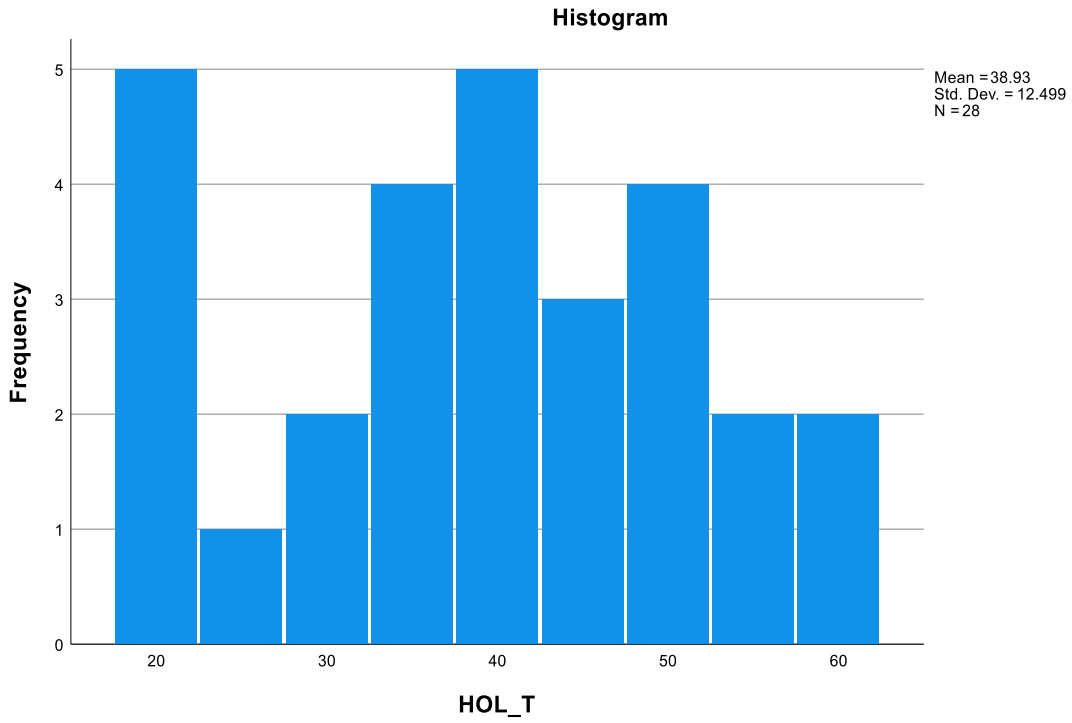


Figure C.5

Q_Q Plot of Learning Strategies Engagement Indicator

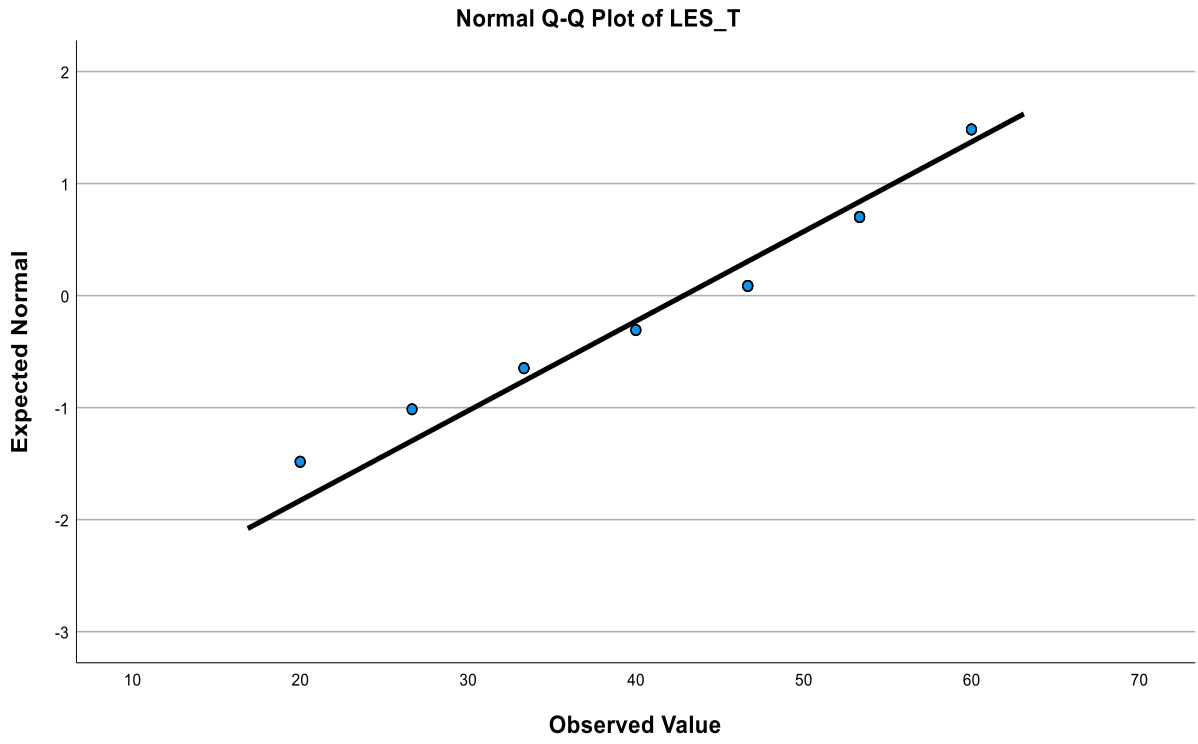


Figure C.6

Histogram Showing Distribution of Learning Strategies Engagement Indicator

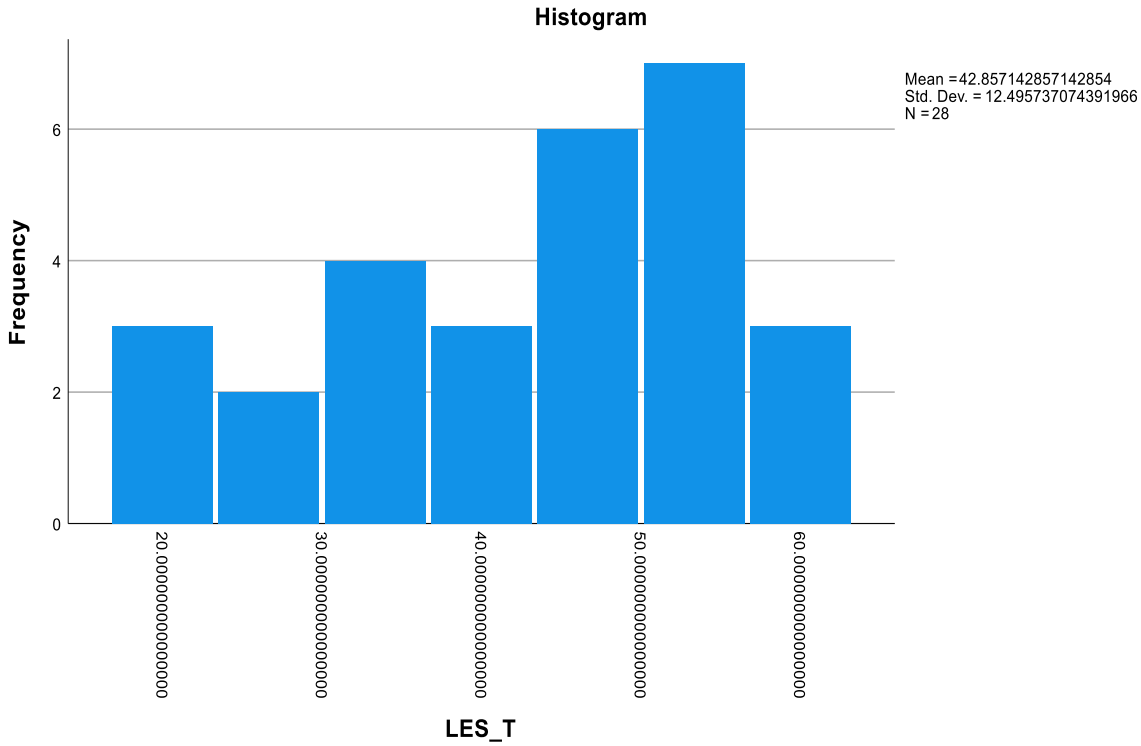


Figure C.7

Q_Q Plot of Quantitative Reasoning Engagement Indicator

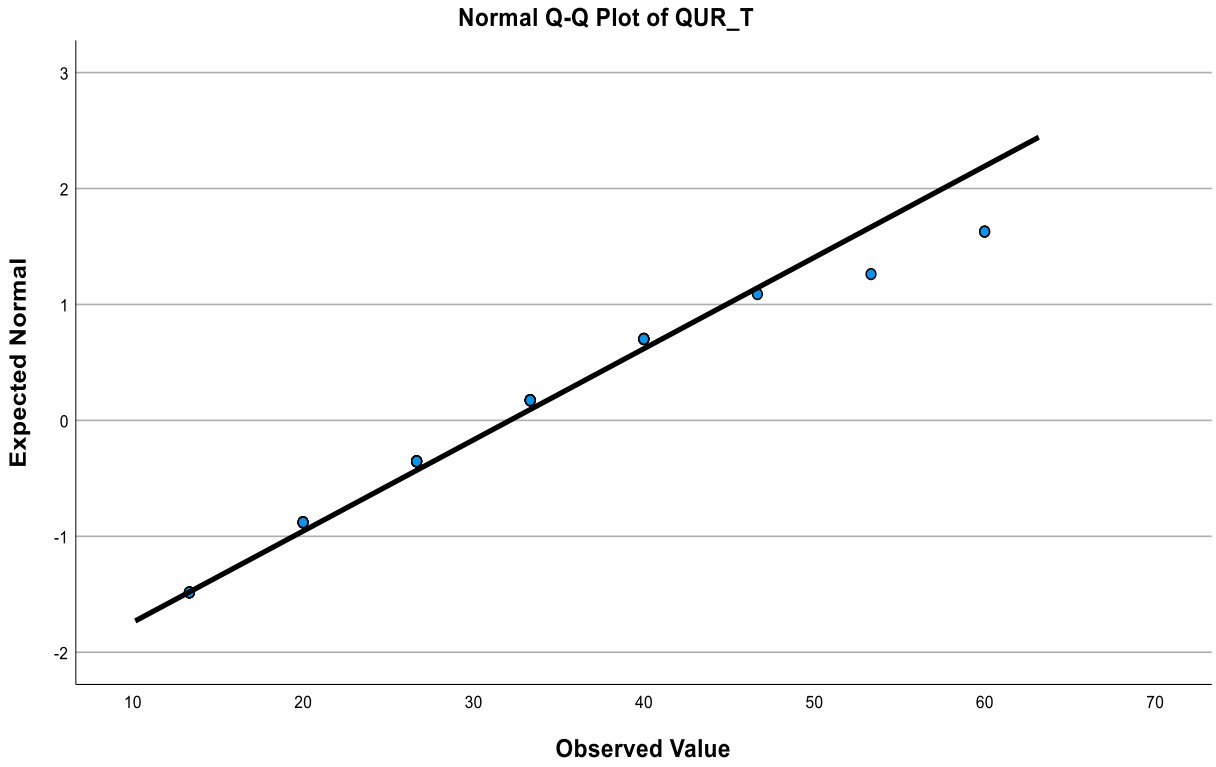


Figure C.8

Histogram Showing Distribution of Quantitative Reasoning Engagement Indicator

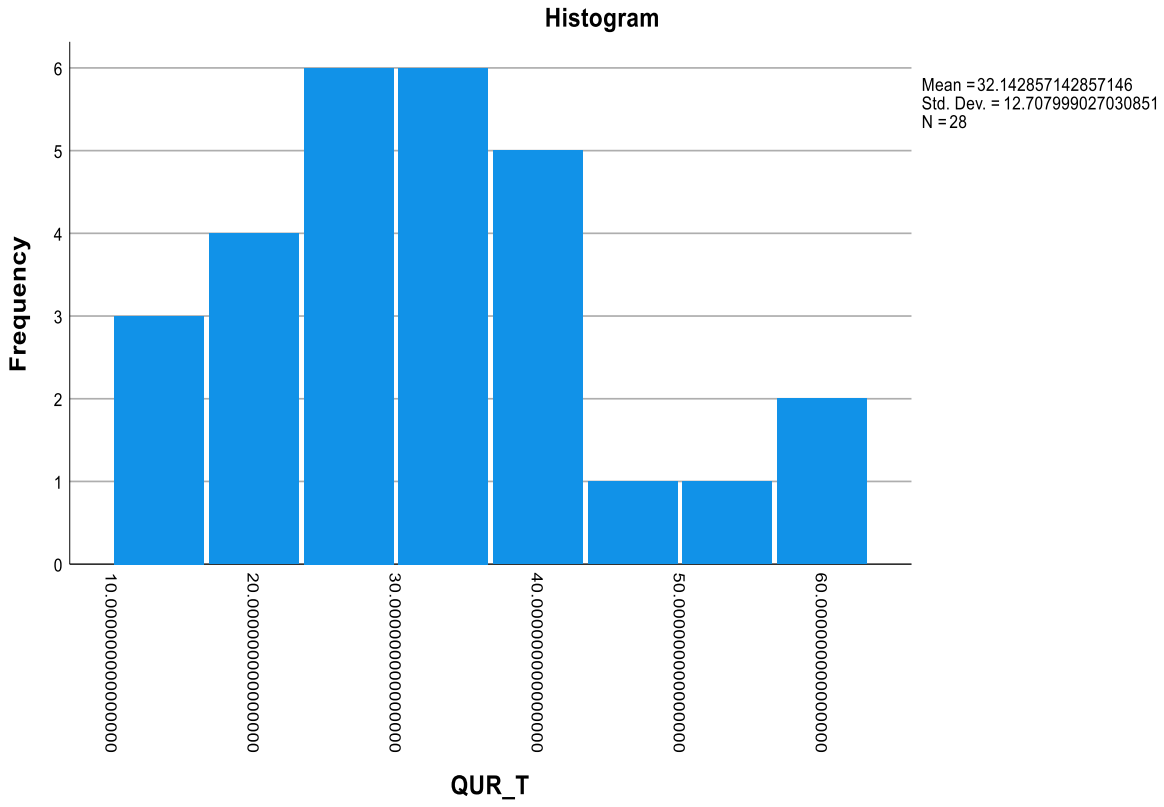


Figure C.9

Q_Q Plot of Collaborative Learning Engagement Indicator

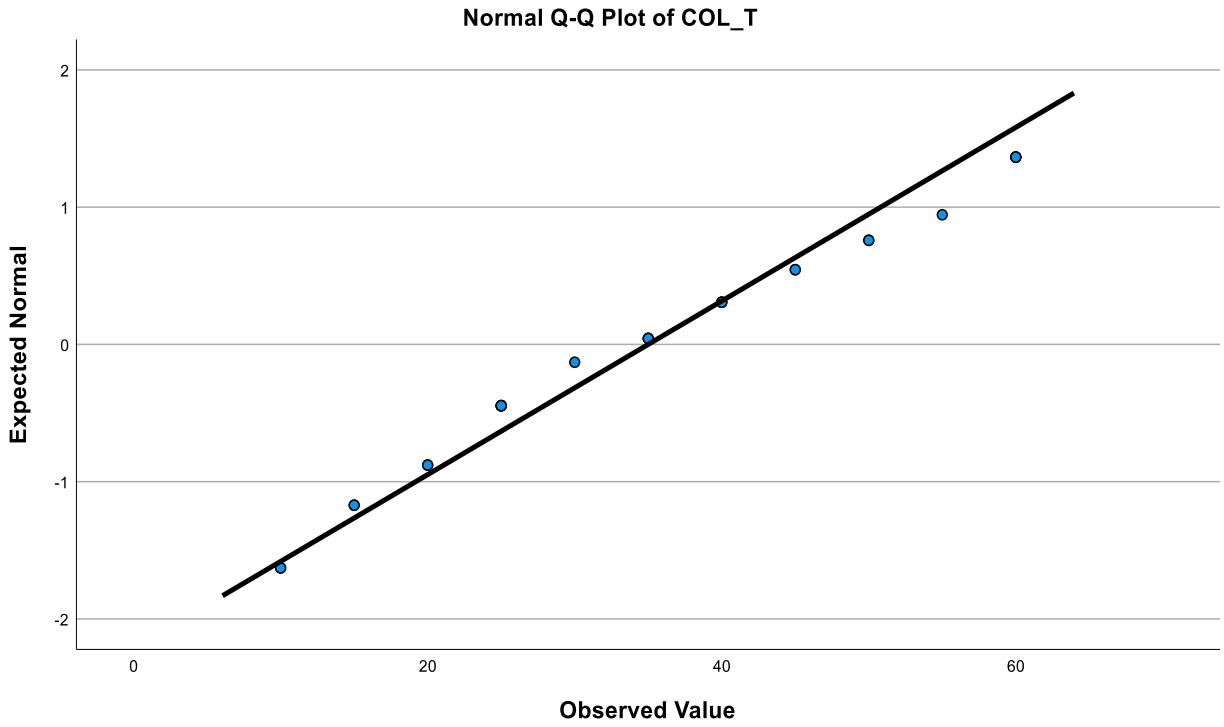


Figure C.10

Histogram Showing Distribution of Collaborative Learning Engagement Indicator

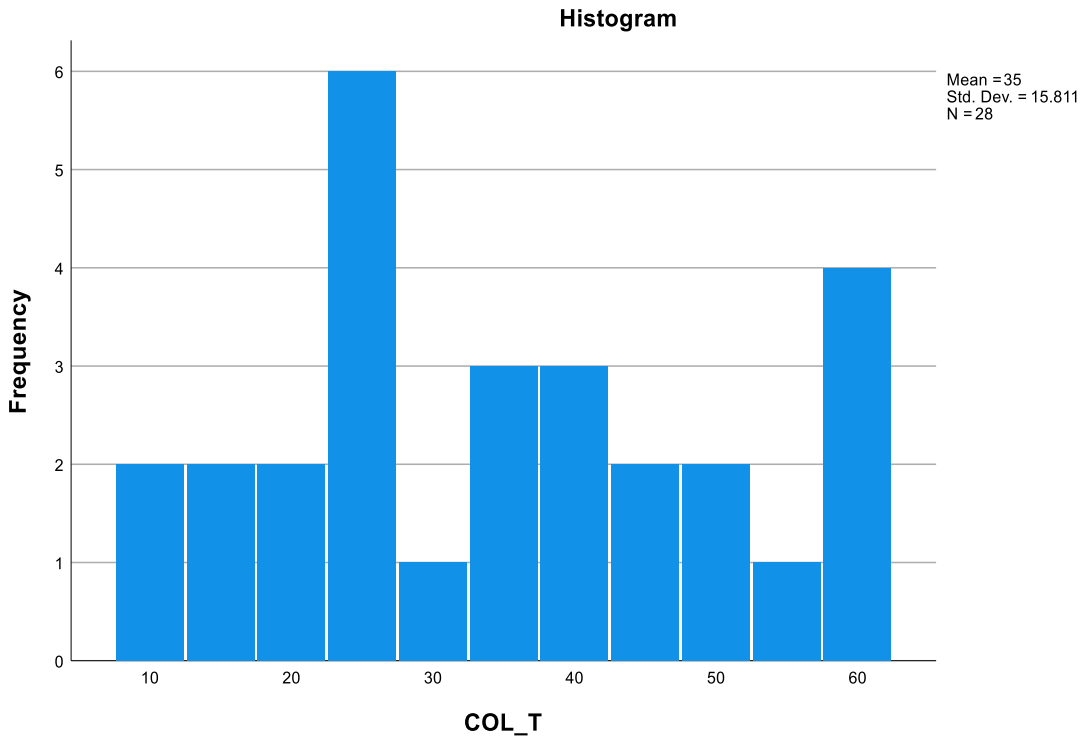


Figure C.11

Q_Q Plot of Discussions with Diverse Others Engagement Indicator

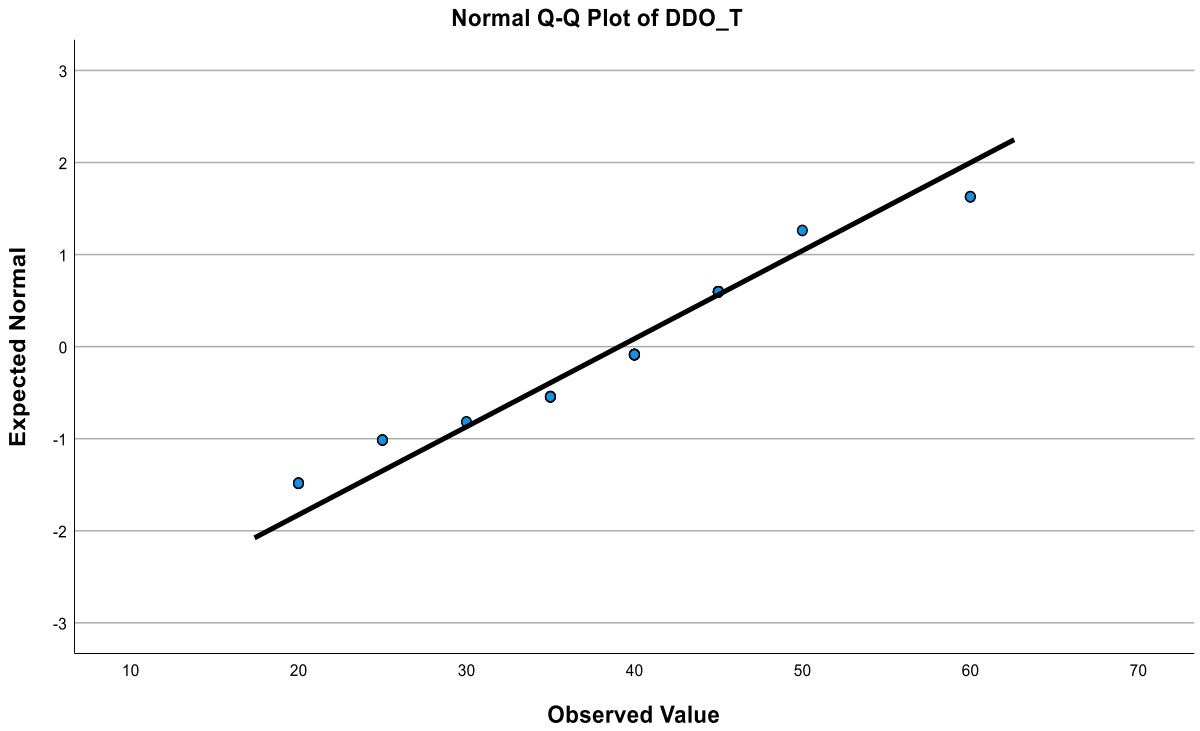


Figure C.12

Histogram Showing Distribution of Discussions with Diverse Others Engagement Indicators

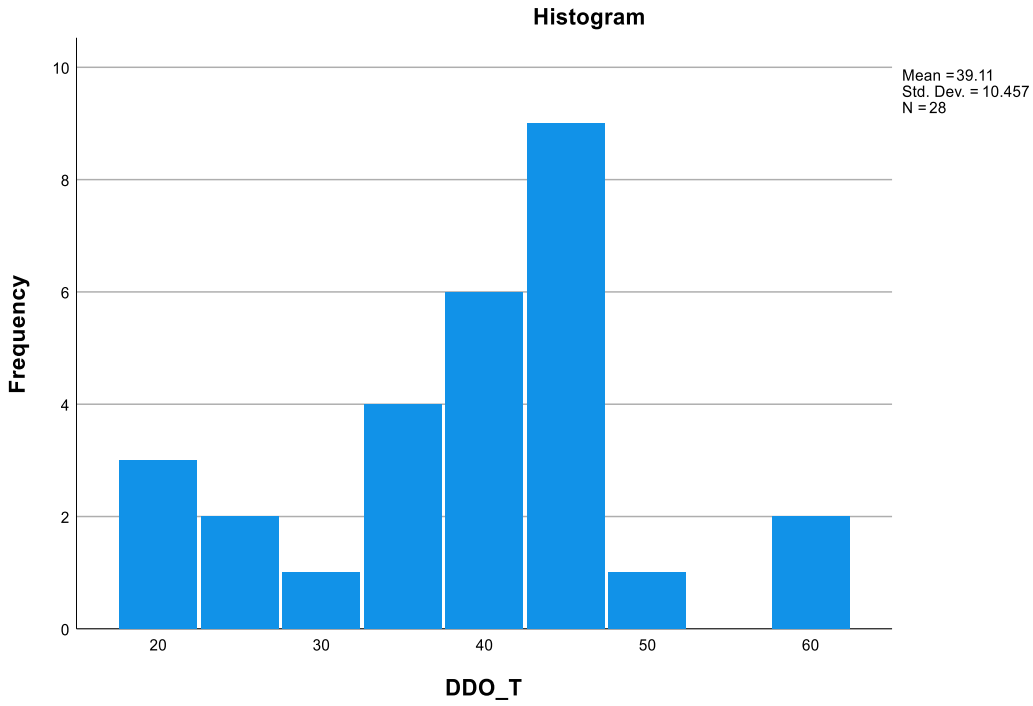


Figure C.13

Q_Q Plot of Effective Teaching Practices Engagement Indicator

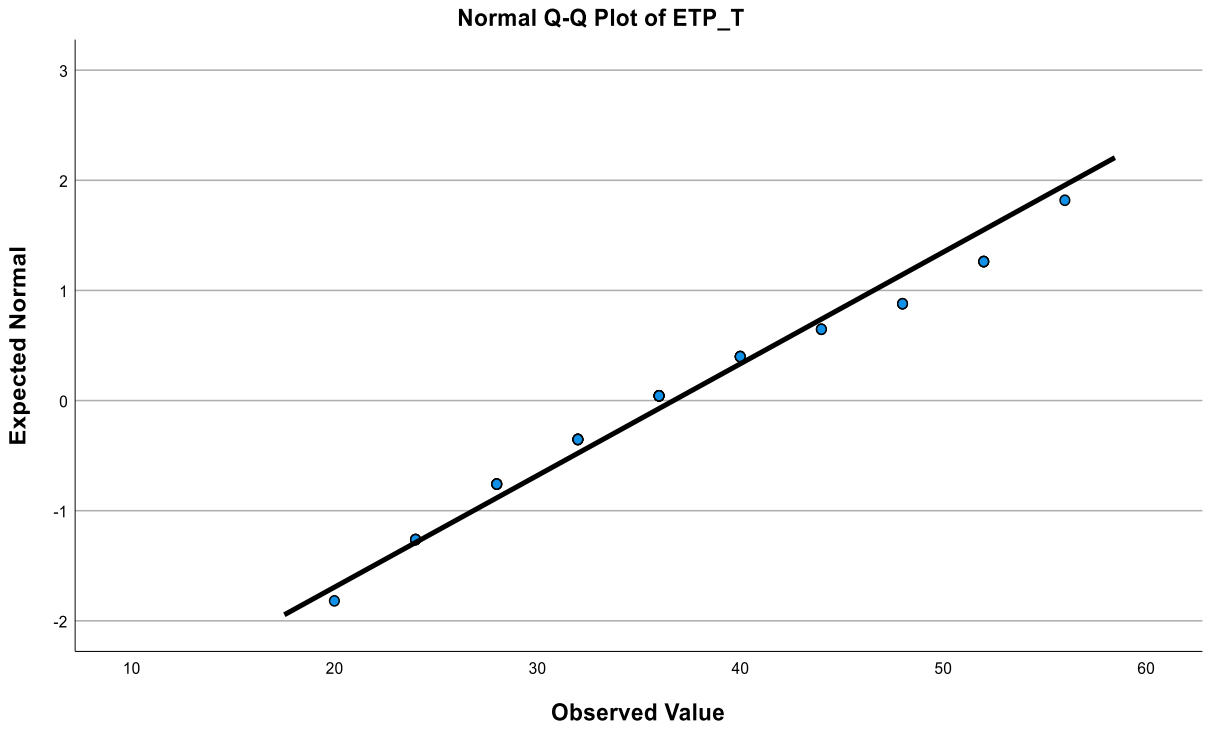


Figure C.14

Histogram Showing Distribution of Effective Teaching Practices Engagement Indicator

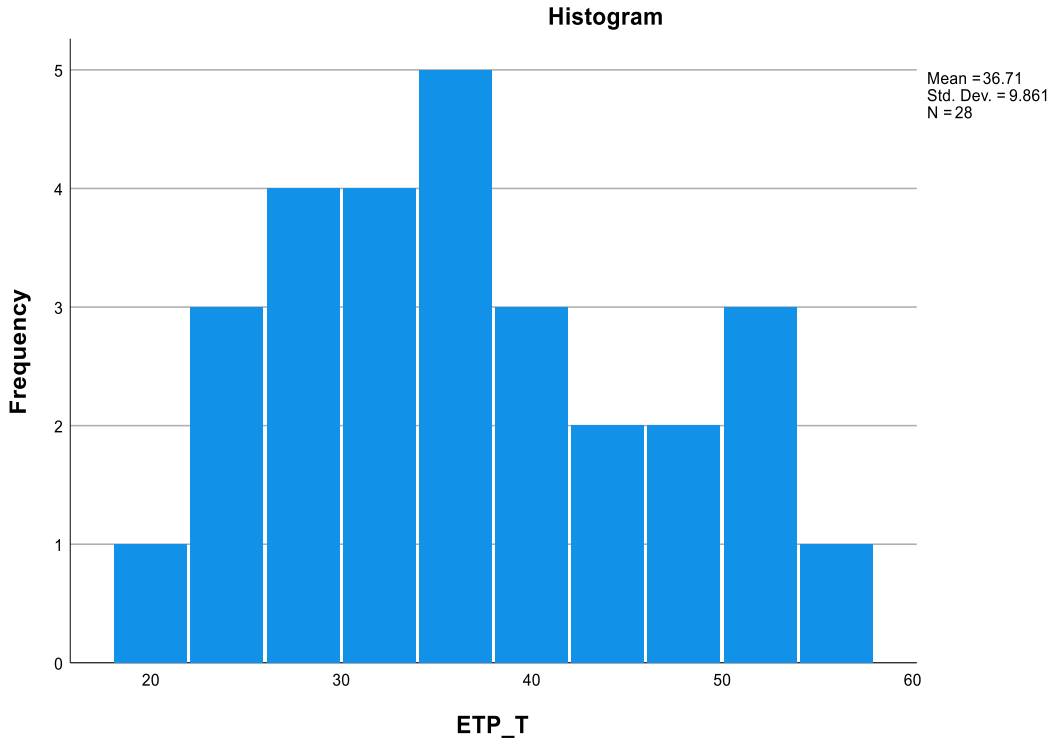


Figure C.15

Q_Q Plot of Quality of Interactions Engagement Indicator

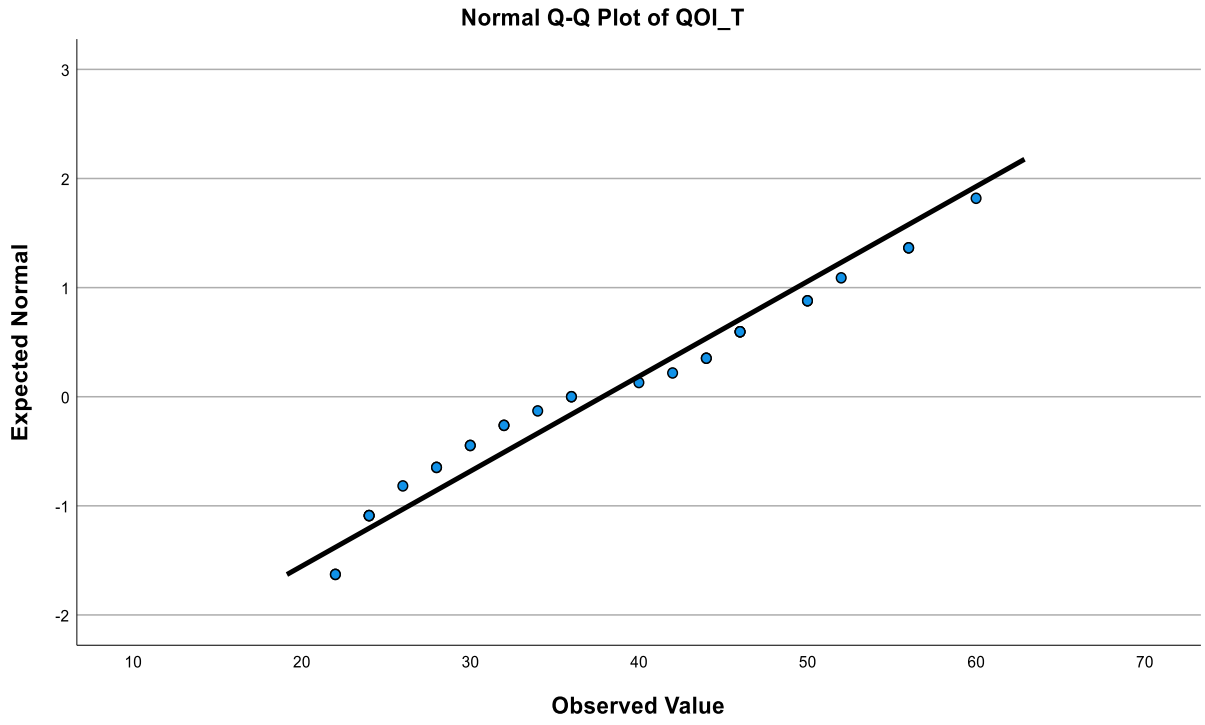


Figure C.16

Histogram Showing Distribution of Quality of Interactions Engagement Indicator

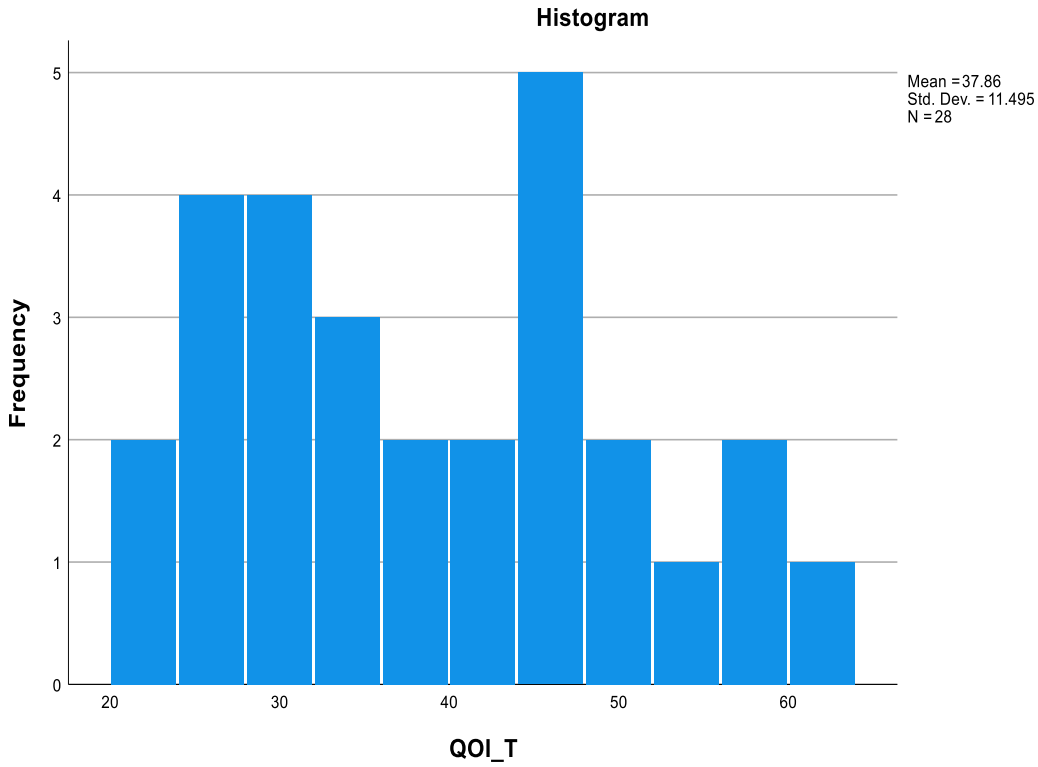


Figure C.17

Q_Q Plot of Supportive Environment Engagement Indicator

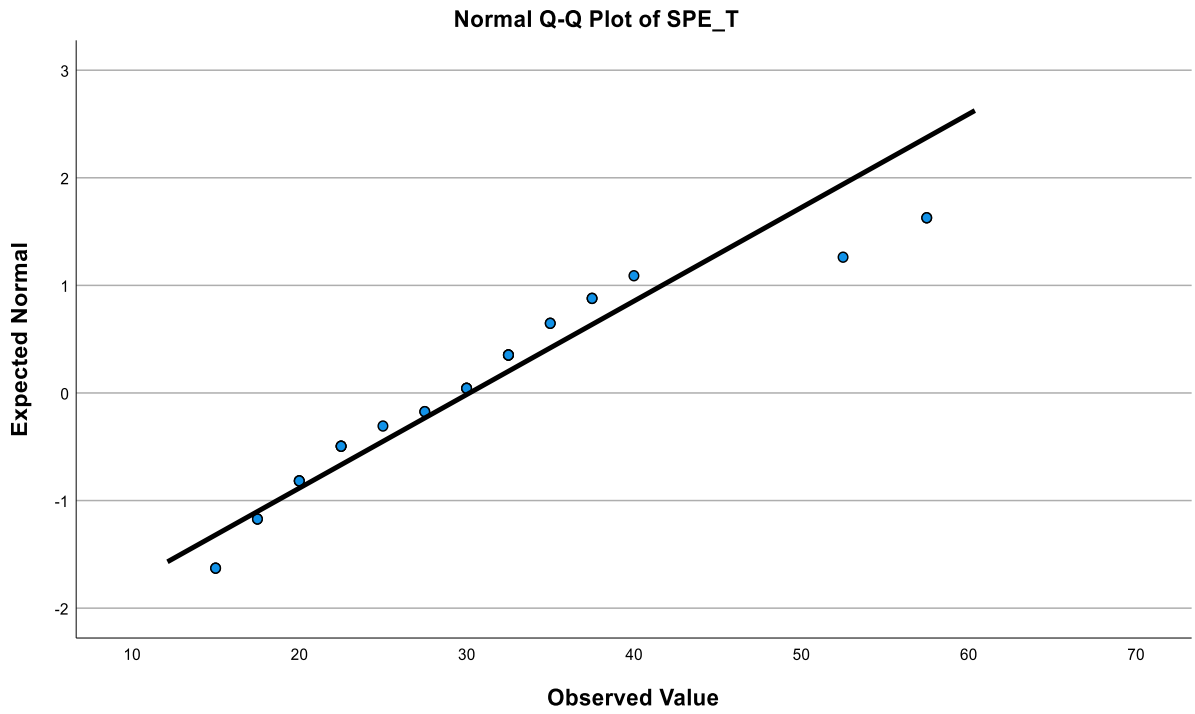


Figure C.18

Histogram Showing Distribution of Supportive Environment Engagement Indicator

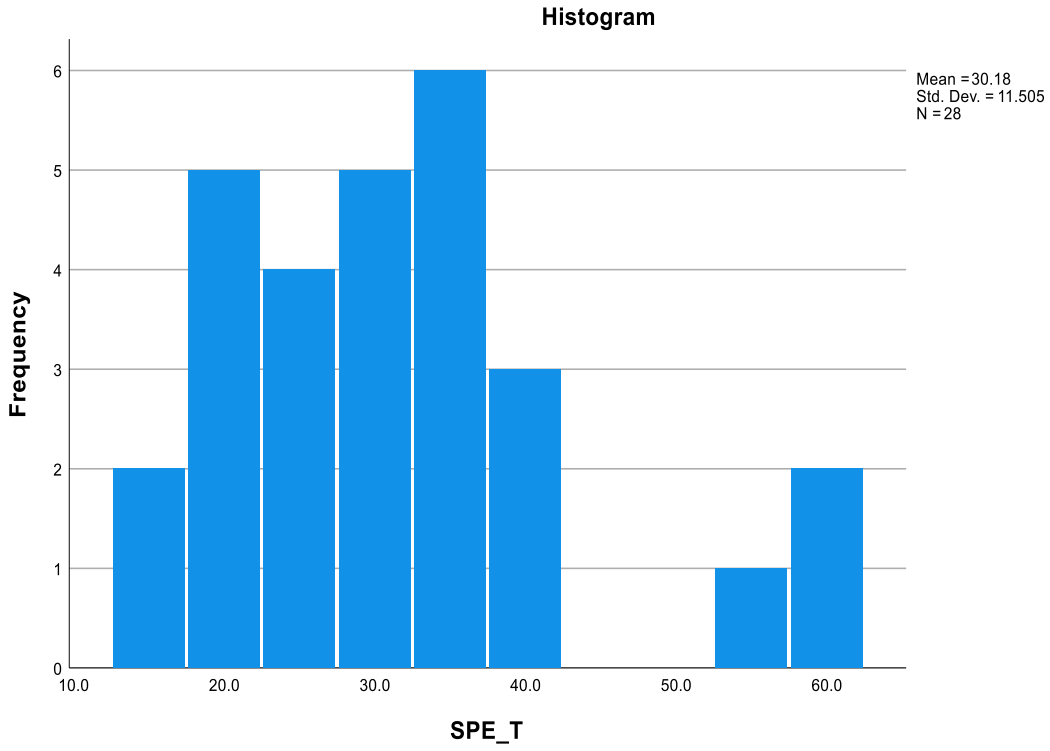


Figure C.19

Q_Q Plot of Academic Challenge Theme

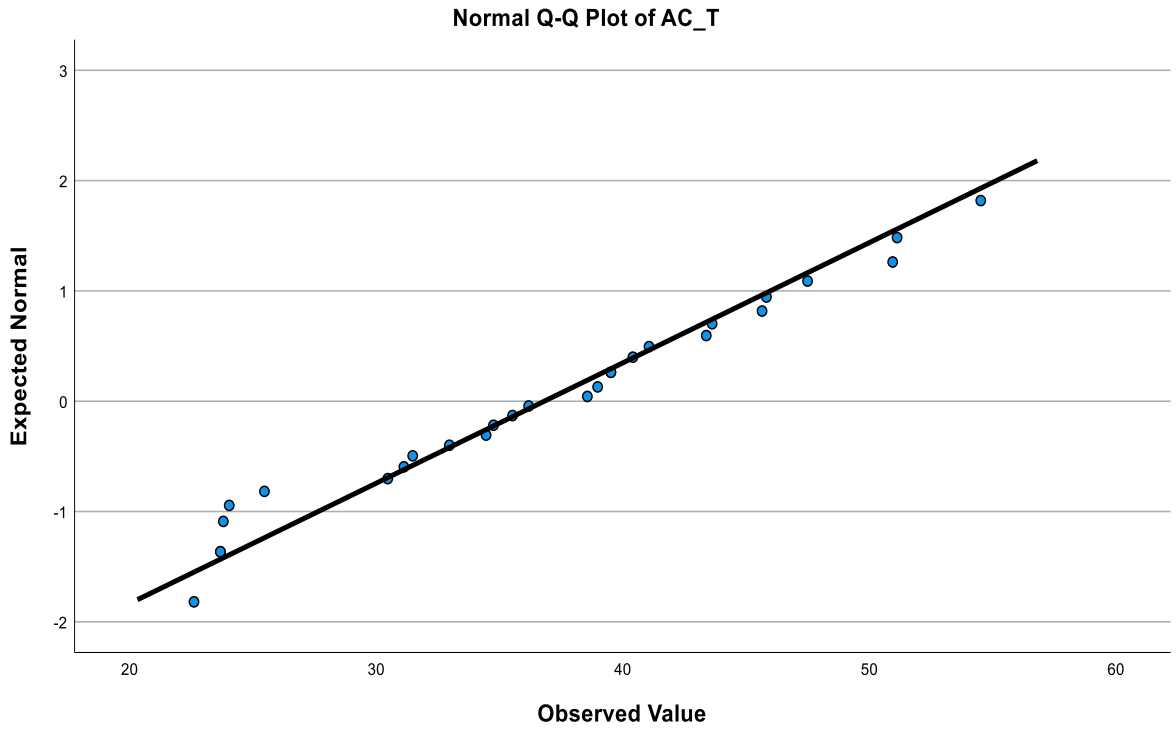


Figure C.20

Histogram Showing Distribution of Academic Challenge Theme

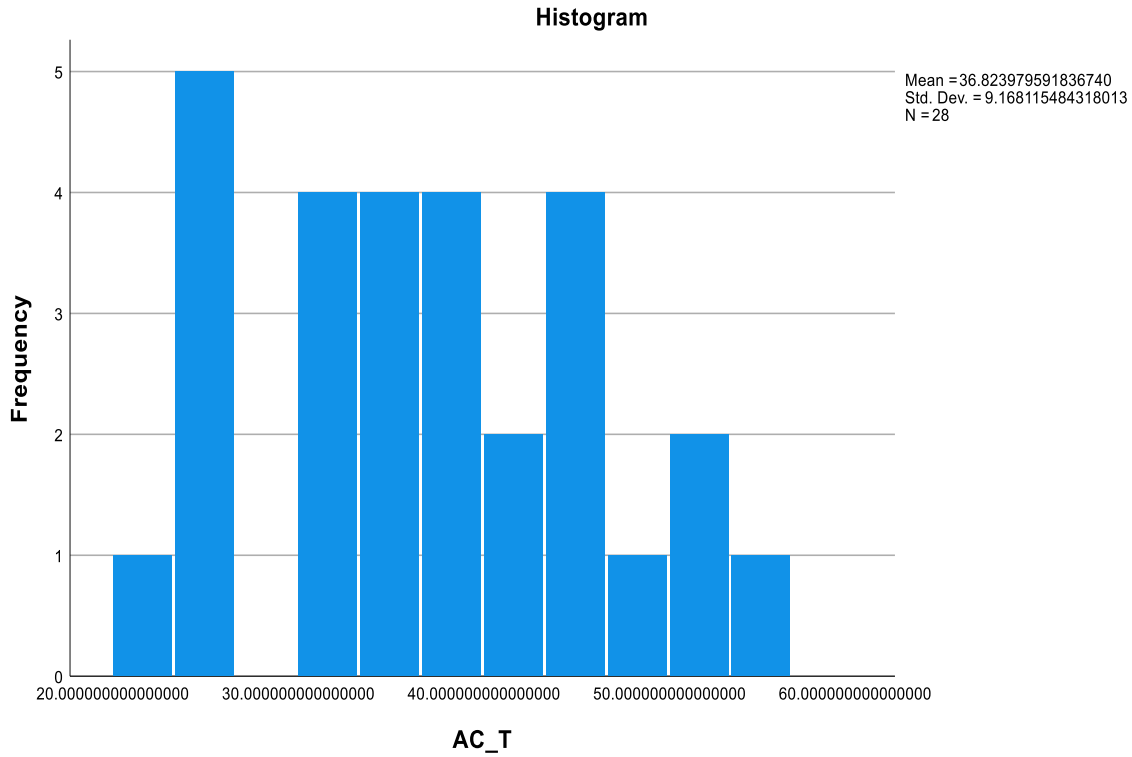


Figure C.21

Q_Q Plot of Learning with Peers Theme

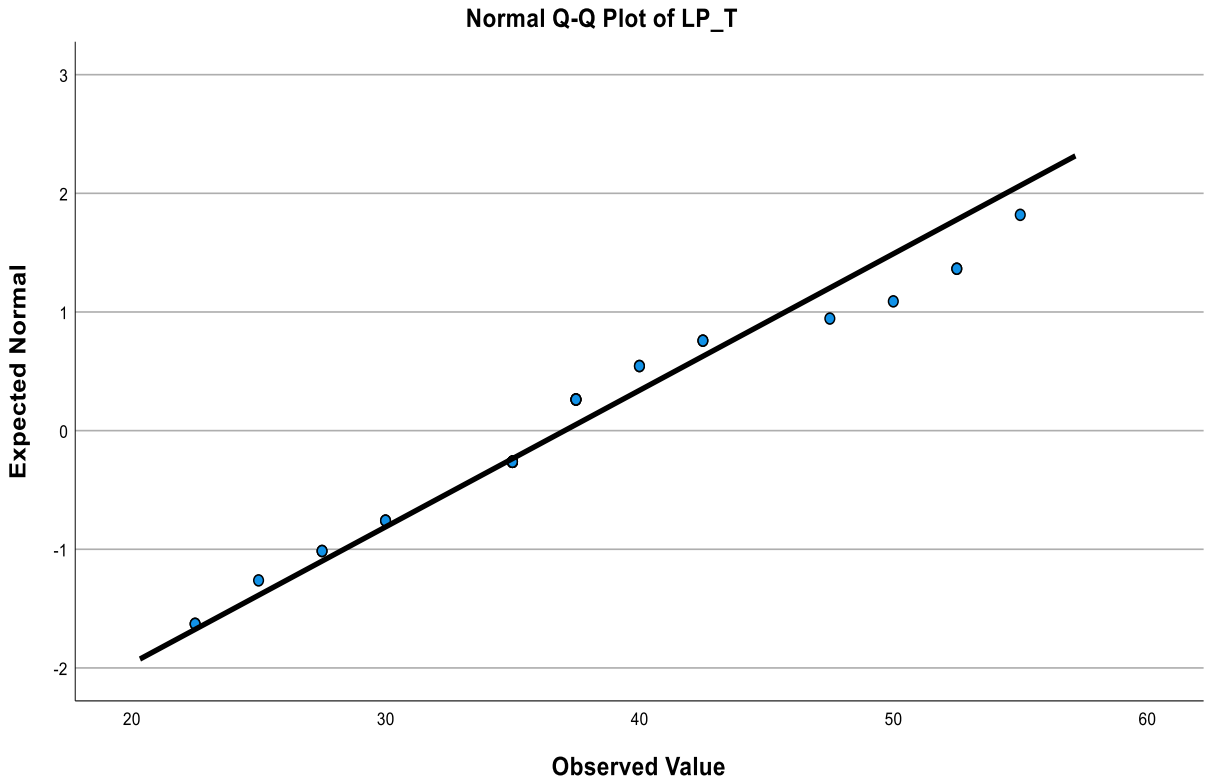


Figure C.22

Histogram Showing Distribution of Learning with Peers Theme

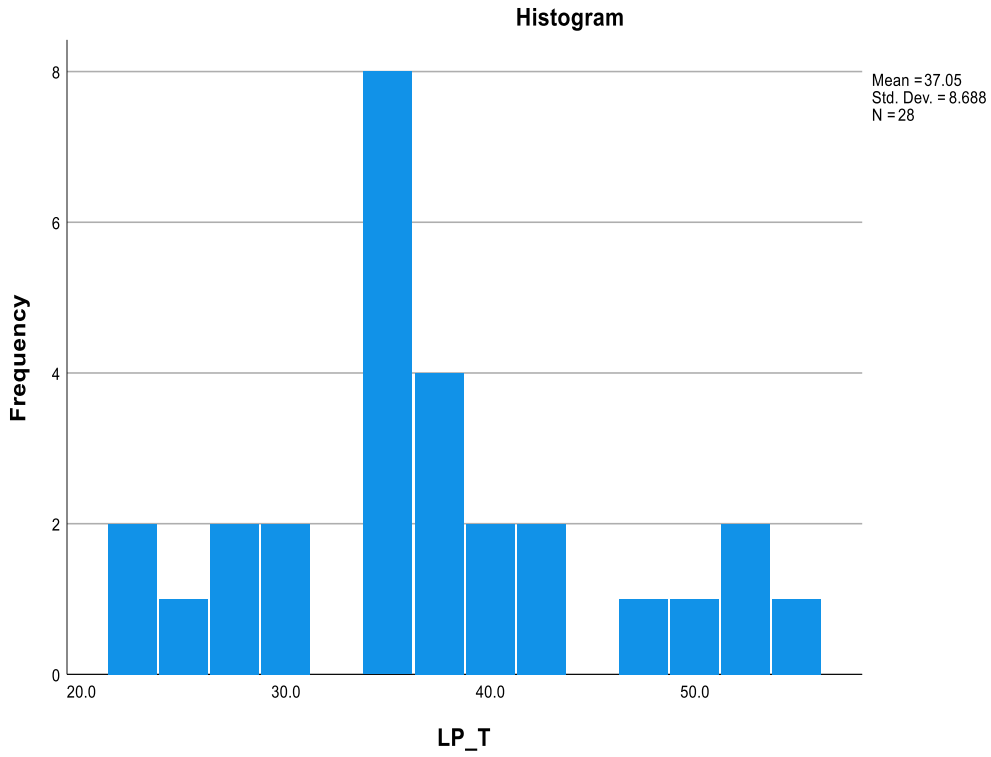


Figure C.23

Q_Q Plot of Experiences with Faculty Theme

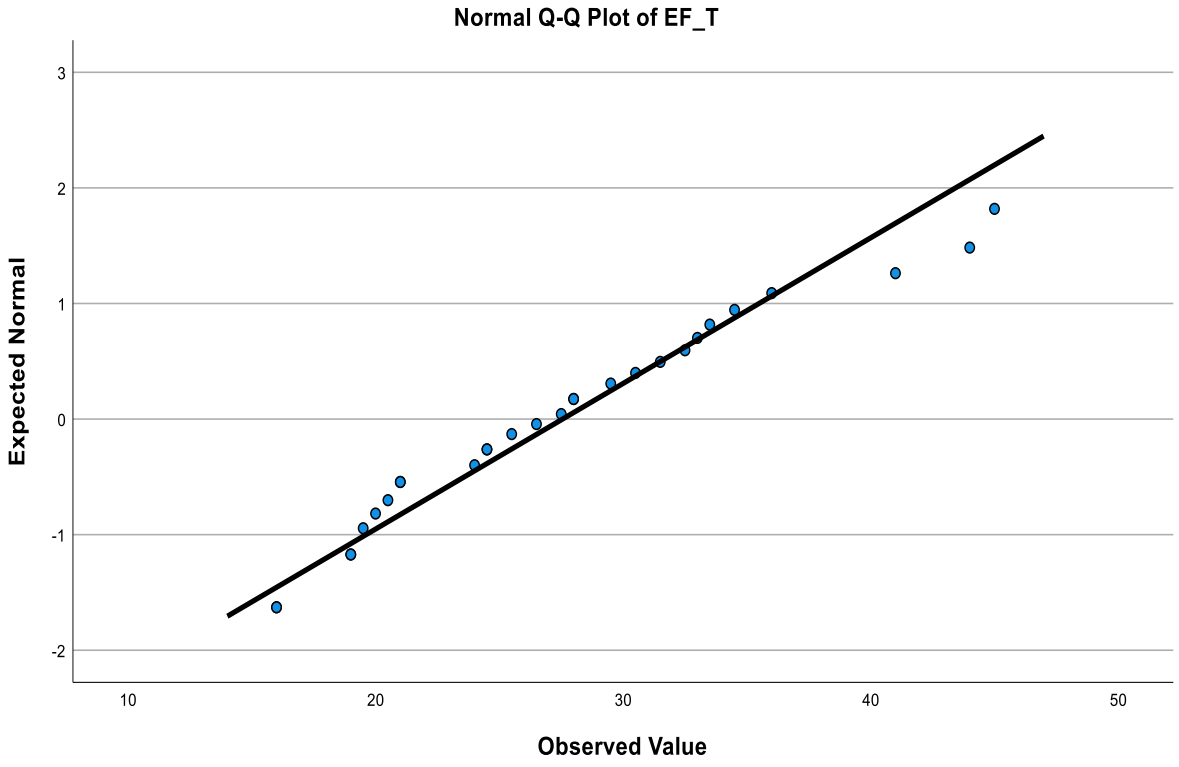


Figure C.24

Histogram Showing Distribution of Experiences with Faculty Theme

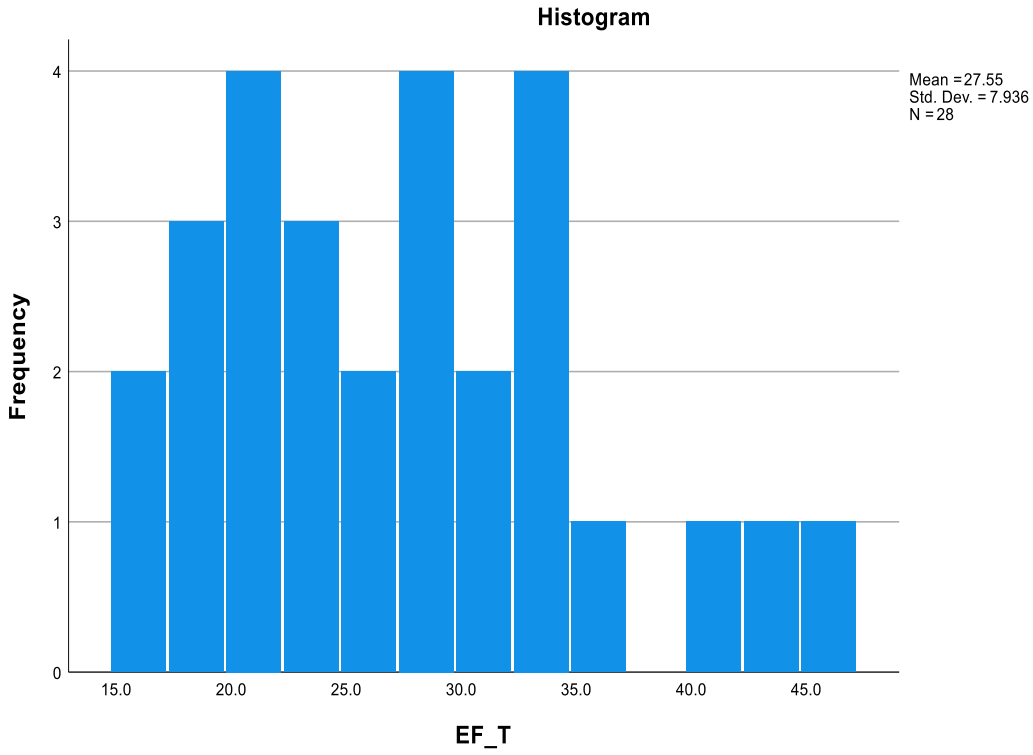


Figure C.25

Q_Q Plot of Campus Environment Theme

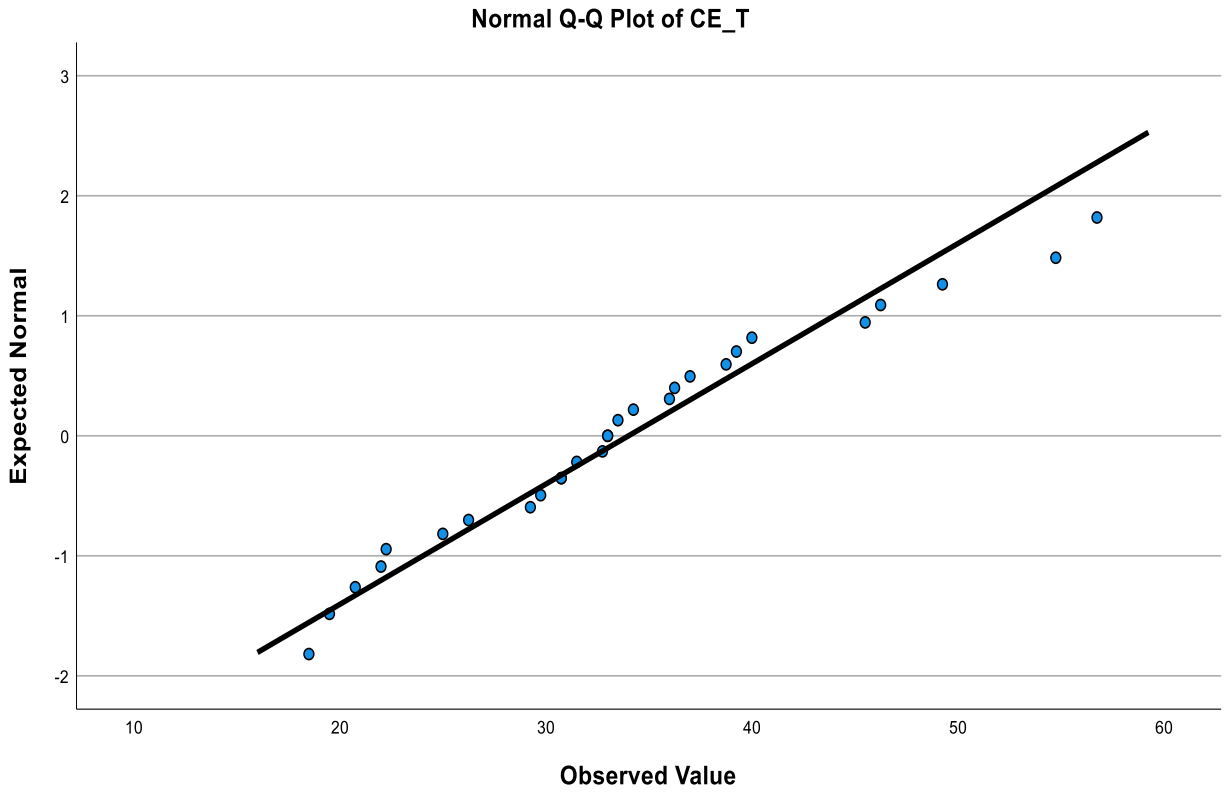
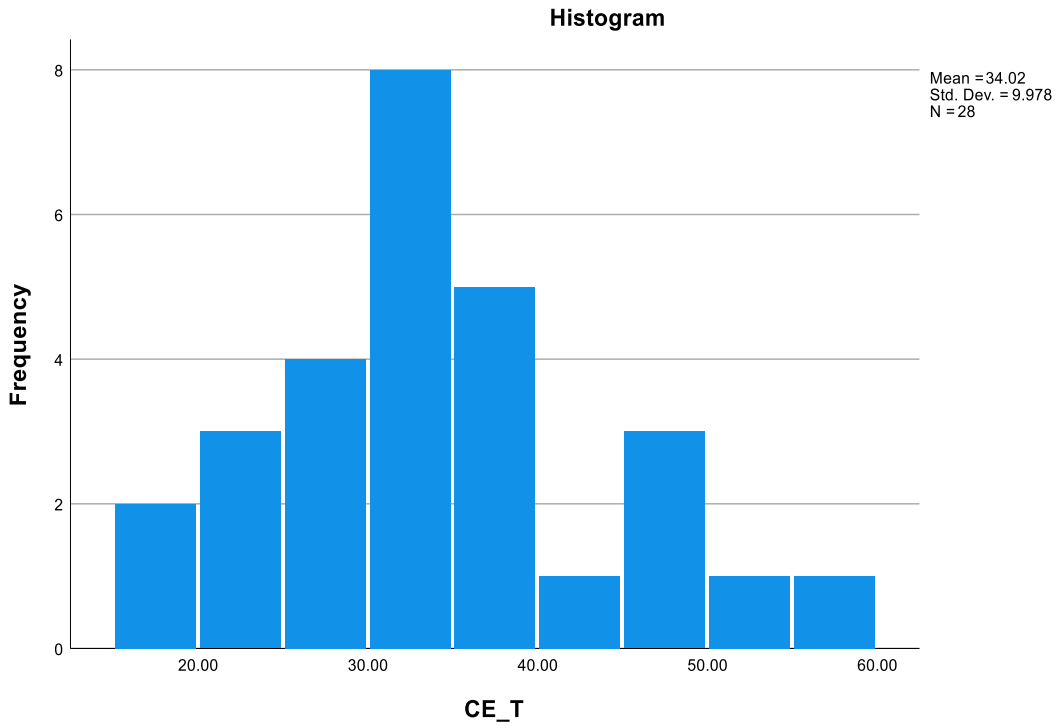


Figure C.26

Histogram Showing Distribution of Campus Environment Theme


Histogram
Mean = 34.02
Std. Dev. = 9.978
N = 28
Frequency
0
2
4
6
8
20.00
30.00
40.00
50.00
60.00
CE_T