Factors Influencing Engineering Student Engagement in Universities in Western Guangdong, China

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Abstract

This study aimed to identify significant factors affecting engineering student engagement in Western Guangdong, China. Additionally, it aims to identify the influence of six independent variables (teaching quality, course content, classroom environment, teacher-student interaction, peer support, and personal motivation) on dependent variables (student engagement). The research employed the Content Validity Index (CVI) for validity and a Cronbach's Alpha for reliability (n=30) of the factor items. Multiple linear regression (MLR) was used to identify the significant factors that affect engineering students' engagement. Four hundred thirty-four students from three target sample universities (Zhanjiang University of Science and Technology, Guangdong Ocean University, and Guangdong University of Petrochemical Technology) participated in this study; 17 questionnaires were deemed invalid due to data errors and random answers. The study revealed that teaching quality, classroom environment, and teacher-student interaction are significant factors in student engagement; there is no significant relationship between course content, peer support, personal motivation, and student engagement. This study endeavors to foster student engagement by exploring the factors that influence it in Western Guangdong, China.

Keywords: Student Engagement, Engineering, Universities

Introduction

Chinese universities face many challenges, like evaluations, restructuring, mergers, and competition for global students. There has been much research on higher education in China for the past 30 years. Most of this research focused on improving teaching and learning quality but only a little on student engagement. Recently, student engagement has been seen as a way to improve the quality of higher education. However, it is not widely used in teaching practice yet (Zhang et al., 2015). Student engagement is important for the quality of a university (Liang, 2019). Exploring student engagement helps universities improve teaching and helps policymakers reform higher education in China (Zhang, Hu & McNamara, 2015).

Research on engineering student engagement has increased in the past decade. More engineering students show a stronger interest in the field. Lichtenstein (2010) used the National Survey of Student Engagement (NSSE) to study 12,000 first-year and second-year engineering students. The study showed that engineering students are better at gaining practical skills like practicing engineering, working with others, using technology, analyzing problems, and solving real-world issues. Compared to other majors, engineering students often tutor others outside class and work in groups (Ball, 2011). Wilson et al. (2014) found that engineering students who were active in academic activities showed higher engagement. Engineering students spend more time preparing for classes but less on certain activities than other majors (Simmons et al., 2018). The outcomes of student engagement in engineering are still of interest to researchers.

The main problem is that higher education students in China must show high engagement levels. Research shows that Chinese students are generally less willing to engage in learning, and their disengagement increases as they progress through their studies (Li, 2020). Disengaged students often learn only surface knowledge. They tend to copy notes, focus on isolated facts and correct answers, and have lower learning outcomes (Kuh et al., 2006). Ing and Victorino (2016) studied engineering students and found that engagement is related to GPA. Students with higher engagement had higher grades, while those with lower grades were less engaged.

There are three main reasons for low student engagement in engineering: students need to understand their majors and learning goals clearly, teachers have impersonal attitudes toward students, and teaching methods and course content need to be updated. According to Liu et al. (2023), engineering students must be prepared with strong career adaptability and professional identity because science and technology in China are rapidly developing. Learning engagement helps improve these traits.

Studying student engagement among engineering students is crucial for improving their educational achievements and future career success. This research aims to identify the factors influencing the engagement of Chinese engineering students in higher education and develop a model to enhance their academic and professional outcomes.

Objective

The research objectives for this study are as follows:

1. To identify the factors influencing engineering students' engagement in higher education.

2. To determine the current levels of engagement and the factors that influence engagement among engineering students in universities in Western Guangdong, China.

3. To identify the significant factors influencing engineering student engagement in universities in Western Guangdong, China.

4. To propose a model to enhance engineering student engagement in universities in Western Guangdong, China.

Literature Review

Theoretical Framework

The school Engagement Framework (Fredricks et al., 2004) and Self-determination Theory (Deci & Ryan, 1985) were used in this study. 2004, Fredricks, Blumenfeld, and Paris created the school engagement framework. It was designed to understand and improve how students get involved in learning. Although the framework was made for school-level engagement, it can also be used to study Chinese engineering students in higher education. In China, engineering students have low engagement levels.

The school engagement framework includes three parts: behavioral, emotional, and cognitive engagement. These can help solve students' behavioral, psychological, and cognitive issues.

Behavioral Engagement: Behavioral engagement is about what students do, like attending class, participating in activities, completing assignments, and following rules. Students who are behaviorally engaged take their academic responsibilities seriously. Behavioral engagement is often the most visible form of engagement.

Emotional Engagement: Emotional engagement is about how students feel in class, including their interest, boredom, happiness, sadness, and anxiety. It also includes their interest in the subject, sense of belonging to the school, and motivation for learning. Emotionally engaged students are likelier to be interested in their learning and feel connected to their school.

Cognitive Engagement: Cognitive engagement involves students' mental efforts to understand their learning experiences. It includes critical thinking, problem-solving, participating in discussions, and applying learned skills to new situations. Cognitively engaged students are more deeply involved in learning and are more likely to succeed.

Engagement levels can vary. For example, behavioral engagement can range from just doing the work and following the rules to joining extra activities. Emotional engagement can range from a superficial liking to a deep identity and belonging to the university. Cognitive engagement can range from memorization to using strategies for deep understanding. All three dimensions are important and interact to affect a student's overall learning experience. This framework provides a comprehensive view of what contributes to student engagement and is used by researchers to assess and improve engagement.

Self-determination Theory (SDT) is a framework for understanding human motivation. It helps explain how our needs and motivations influence behavior. Edward Deci and Richard Ryan introduced it in the 1980s, and it is widely used in educational research. The main parts of SDT are psychological needs and intrinsic motivation. Deci (1975) suggested that intrinsic motivation is a key example of self-determined activities. SDT also highlights that a person's social environment is important for motivation. It helps motivation by providing choices, meaningful feedback, chances to improve, and supportive relationships.

There are three basic psychological needs in SDT: autonomy, competence, and relatedness. Autonomy: Autonomy refers to the need to feel like you have a choice in what you do. People want to act according to their values, preferences, and interests, not because of

outside forces. When people, including students, feel autonomous, they are more motivated and engaged. Competence: Competence refers to the need to feel capable and effective in what you do. People want to develop skills, feel a sense of mastery, and see themselves as competent. This makes them more motivated and persistent in their goals. Relatedness: Relatedness refers to the need for social connections and belonging. Feeling connected, supported, and understood by others contributes to well-being and motivation.

According to SDT, there are two types of motivation: intrinsic and extrinsic. Intrinsic Motivation: Intrinsic motivation refers to when people do an activity because they find it enjoyable or satisfying. They do it for its own sake, not because of external rewards or pressures. Extrinsic Motivation: Extrinsic motivation refers to people doing an activity for external rewards or avoiding consequences. Rewards can include money, praise, or social approval; consequences can include punishment or disappointment. SDT is used in this study to understand what (the content) and why (the process) drives the development of engineering student engagement.

Student Engagement

According to Kuh (2009), student engagement is the time students spend on tasks related to learning, teaching quality, and interaction with faculty. Barkley (2010) said student engagement is "the product of motivation and active learning." If one element is missing, engagement does not occur. Christenson et al. (2012) defined student engagement as active participation in school activities and commitment to educational goals. Many researchers have defined student engagement in different but related ways.

a. There are three dimensions of student engagement. Behavioral engagement focuses on students' effort and time in course activities and discussions (Manwaring et al., 2017). It is easier to measure because it can be seen. A meta-analysis found that behavioral engagement is linked to higher academic achievement, followed by cognitive and emotional engagement (Lei et al., 2018). Behavioral engagement includes participating in scientific, social, and co-curricular activities. Lane and Harris (2015) described behaviors of engaged students as listening, writing, and interacting with instructors and behaviors of disengaged students as being unresponsive and distracted. Nguyen, Cannata, and Miller (2018) found that students were more engaged when interacting with classmates and teachers. Behavioral engagement is divided into active, passive, and disengagement (Ball, 2011). A study of 276 students at a Taiwanese university showed that good group interaction led to high behavioral engagement (Lai, 2021).

Emotional or affective engagement is an intrinsic and psychological part of student engagement (Farnsworth et al., 2022). Taylor and Statler (2014) showed that emotionally engaged people learn more effectively. Pekrun and Perry (2014) found that positive emotions like curiosity promote learning, while negative emotions like boredom inhibit it. Maguire et al. (2017) suggested that emotional intelligence can enhance relationships and engagement. Kahu (2014) found that interest leads to happiness and increases behavioral and cognitive engagement through interviews with 19 undergraduates.

Cognitive engagement relates to motivation, such as goals and self-efficacy (Greene, 2015). Osman et al. (2014) said that cognitive engagement is shown by how students feel about the educational process and the strategies they use for tasks. Cognitive engagement helps students recognize their learning progress. Emotional and cognitive engagement are connected, but emotional engagement does not necessarily lead to higher cognitive engagement (Manwaring, 2017). There are commonalities and differences in cognitive processes across disciplines like education and engineering; for example, the study identified Extraverted Intuition as the highest frequency in both our groups; however, the two groups show significant differences in the use of Introverted Intuition and Introverted Thinking (Ball, 2011).

Research shows that students engaged in schoolwork are likelier to achieve high and continue their education (Finn & Zimmer, 2012; Fredricks et al., 2004). This means that the more engaged a student is, the better their academic achievement. Finn (1993) developed a participation-identification model to explain how engagement affects academic achievement, suggesting that disengaged behavior leads to poor academic performance. Wong et al. (2017) found that more engaged students have better outcomes. Additionally, there is a reinforcing relationship between engagement and learning outcomes. Increased engagement improves learning outcomes, which, in turn, boosts perception and engagement levels (Kahu, 2013). Zen (2022) showed that student engagement increased academic performance through project-based learning experiences. Guo (2023) studied second and fourth-year college students (N = 966) and found that engagement is important for learning outcomes. Afzal and Crawford (2022) also identified a significant link between engagement and performance in online learning using the SEM method.

Engaging learners is essential for positive academic and behavioral outcomes among university engineering students. Engagement (e.g., setting realistic goals, completing assignments, communicating with teachers, and maintaining high-class attendance) leads to more positive academic performance. Students who engage in class, complete their work and stay on task achieve high learning outcomes.

Conceptual Framework of the Study

Figure 1 shows the conceptual framework of this study. The conceptual framework for this study is shown as an Inputs-Process-Output (IPO) figure to depict the research process, which involves both qualitative and quantitative research. Input (I) refers to the theories and variables that form the basis of this research, including school engagement framework theory and self-determination theory; school engagement framework theory points to student engagement (DV), and self-determination theory points to the factors (IV). The process (P) refers to the methods and statistics used to obtain and analyze data, which includes five steps: the first step is literature synthesis and content analysis, the second step is instrument development, the third step is data collection, the fourth step is descriptive and inferential statistics, and the fifth step is model development and validation. The output (O) refers to the final product of this research, which is intended to be a statistical model to enhance engineering student engagement in the intended context, which is the purpose of this study.

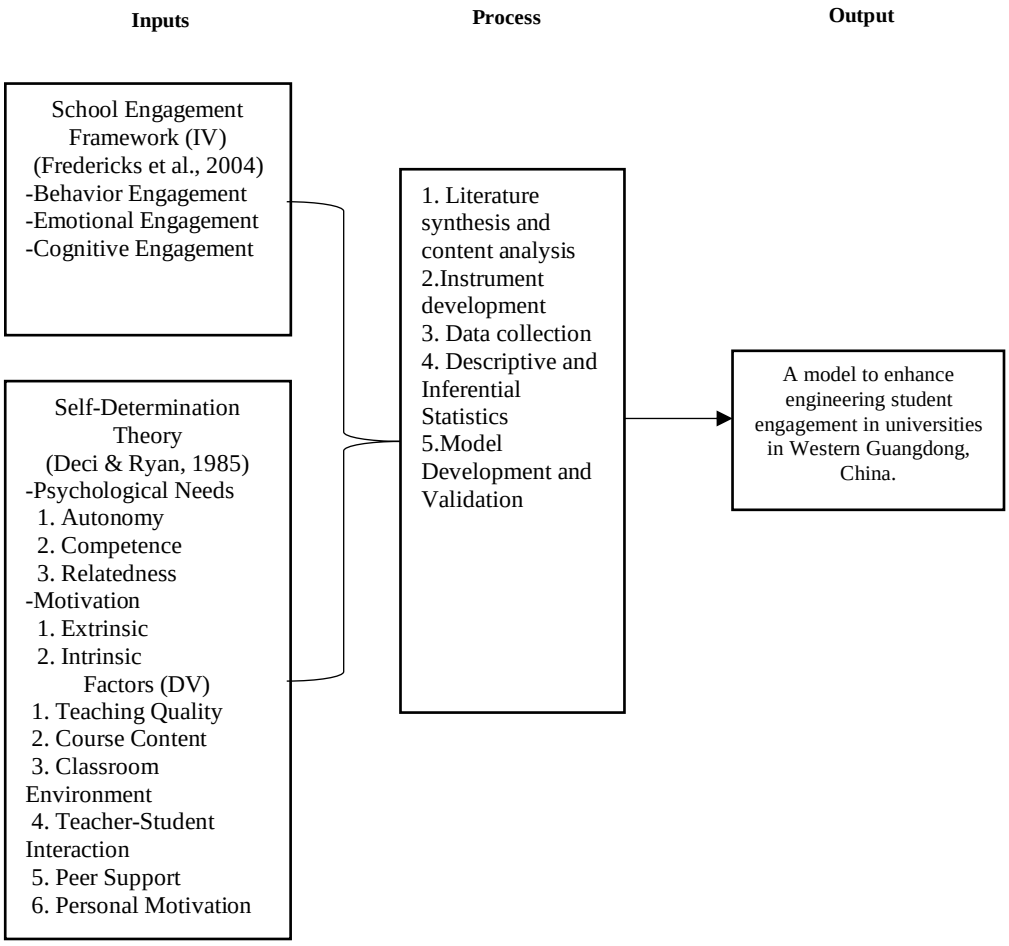

Figure 1: Conceptual Framework

Research Methodology

This study used an explanatory mixed-method approach to develop the research design. According to Creswell and Poth (2016), this approach creates or refines a research instrument, such as a survey or questionnaire, through quantitative and qualitative methods. This design was useful because the researcher aimed to develop an instrument related to the factors influencing student engagement in this context.

The research began with a qualitative phase. For this phase, the researcher used content analysis and literature synthesis to identify key constructs or factors affecting student engagement and to generate question items for the instrument. Both the constructs and the question items were used to evaluate content validity. The validated instrument was then tested for reliability in a pilot test. Once content validity and reliability were confirmed, the instrument collected data for the quantitative research phase.

This study distributed the instrument to the target population for the quantitative phase using the designated minimum sample size. Data analysis used descriptive and inferential statistics such as means, standard deviation, frequencies, and percentages. Multiple linear regression was used to determine the significant factors affecting student engagement in this context.

Population and Sample

Three universities with engineering majors were included in the study: Guangdong Ocean University, Guangdong University of Petrochemical Technology, and Zhanjiang University of Science and Technology. The stratified random sampling method was used in this study, and the minimum sample size was determined using the Krejcie & Morgan table. Based on a population size of 1,739, the minimum sample size is 313. Guangdong Ocean University has a total population of 192 engineering students, Zhanjiang University of Science and Technology has 935 engineering students, and Guangdong University of Petrochemical Technology has 612 engineering students. The population includes first-, second-, and third-year engineering students. Fourth-year students were not selected because they were about to graduate and might need to take the questionnaire seriously, leading to inaccurate or useless data. Table 1 shows the population and sample size.

Table 1: Population and Sample Size of the Study

University	No. of Engineering Students	Sample Size
Guangdong Ocean University	192	35
Zhanjiang University of Science and Technology	935	168
Guangdong University of Petrochemical Technology	612	110
Total	**1,739**	**313**

Research Instrument and Data Collection

Two sets of questions comprised the instrument. The first set of questions came from The University Student Engagement Inventory (USEI), developed by Maroco et al. (2016), which was used to measure levels of engineering student engagement. The USEI is a validated tool containing 15 items designed to measure three dimensions of student engagement: Behavioral Engagement (BE), Emotional Engagement (EE), and Cognitive Engagement (CE). The second set of questions was developed for the study. To measure the factors influencing engineering student engagement, items were developed, validated, and tested for reliability.

Data Analysis

Descriptive statistics were employed to determine the levels of engineering students' engagement. The analysis included common descriptive statistics such as frequencies, percentages, mean, and standard deviation (SD). The mean and SD were used to measure central tendency and variability. Frequencies and percentages were also calculated for the demographic data, providing a comprehensive overview of the sample characteristics.

Multiple Linear Regression was used to identify the significant factors. This statistical technique and Jamovi software were employed for data analysis and predictive modeling to explore and quantify the relationship between a dependent variable (the outcome or target variable) and two or more independent variables (predictor variables). In this study, the dependent variable was the level of student engagement, while the independent variables were the six factors.

Research Finding

Research Objective 1

Quantitative content analysis was carried out. This research method systematically identifies words, themes, or concepts through numerical techniques, the objective of which is to quantify their presence. From the original analysis, the findings were reduced to six factors said to affect student engagement. They comprise *teaching quality, course content, classroom environment, teacher-student interaction, peer support, and personal motivation.*

Research Objective 2

Table 2 shows the current level of engagement for the engineering students in the sample. Overall, they reported that their current level of student engagement was high (3.58). Three constructs, behavioral engagement, with a mean of 3.86 and SD of 0.816, and cognitive engagement, with a mean of 3.55 and SD of 0.842, were at a high level; emotional engagement, with a mean of 3.34 and SD of 0.847, was perceived as being at the moderate level.

Table 2: Respondents Reported Current Levels of Student Engagement (n = 417)

Student Engagement	Mean	S.D.	Interpretation
Behavioral Engagement	3.86	0.816	High
Emotional Engagement	3.34	0.847	Moderate
Cognitive Engagement	3.55	0.842	High
Overall	**3.58**	**0.750**	**High**

Table 3 shows the respondents reported the factors influencing student engagement. Furthermore, six factors were at a high level: teaching quality, with a mean of 3.65 and SD of 0.857; course content, with a mean of 3.72 and SD of 0.888; classroom environment, with a mean of 3.68 and SD of 0.847, teacher-student interaction, with a mean of 3.68 and SD of 0.844, peer support, with a mean of 3.73 and SD of 0.866, personal motivation, with a mean of 3.73 and SD of 0.901.

Table 3*:* Respondents Reported Levels of Factors Influencing Their Engagement (n=417)

Factors Variables	Mean	SD	Interpretation
Teaching quality	3.65	0.857	High
Course content	3.72	0.888	High
Classroom environment	3.68	0.847	High
Teacher-student interaction	3.68	0.844	High
Peer support	3.73	0.866	High
Personal motivation	3.73	0.901	High
Overall	**3.70**	**0.814**	**High**

Research Objective 3

Multiple linear regression was used to analyze the significant factors influencing engineering student engagement. The results indicated that teaching quality, classroom environment, and teacher-student interaction were significant for student engagement because of *p<.05. Course content, peer support, and personal motivation are not significant for student engagement because of *p＞.05. The R is 0.871, the R-squared (R^2) is 0.758, this means in a multiple linear regression model with six factors (e.g. teaching quality, course content, classroom environment, teacher-student interaction, peer support and personal motivation) variables can account for 75.8% of the variability in student engagement. Table 3 shows a summary of the regression results on each of the factors.

Table 3: Summary of Results of Multiple Linear Regression on Factor Variables and Student Engagement

Predictor		Estimate	SE	t	p
1	Intercept	0.6521	0.0847	7.698	＜.001
	TQ	0.4064	0.0557	7.298	＜0.001
	CC	0.0492	0.0500	0.985	0.325
	CM	0.2281	0.0612	3.729	＜0.001
	TSI	0.0359	0.0695	2.517	＜0.001
	PS	0.1023	0.0522	1.961	0.051
	PM	0.0465	0.0431	1.079	0.281

b. Dependent Variable: *Student Engagement*, *p<.05
c. TQ (Teaching Quality), CC (Course Content), CM (Classroom Environment), TSI (Teacher Student Interaction), PS (Peer Support), PM (Personal Motivation)

Research Objective 4

Regarding the demographic variables, the type of university (public or private) influenced behavioral, emotional, and cognitive engagement significantly. Whether the major was the student's first choice was only significantly related to emotional engagement. For overall student engagement, only whether the major was the first choice was found to be significant. As for influencing factors, Teaching Quality and Classroom Environment were significantly related to all types of engagement (overall, behavioral, emotional, and cognitive). Peer Support was found to be significant for only behavioral engagement. For overall student engagement, the following were significant: Teaching Quality, Classroom Environment, and Teacher-Student Interaction. Multiple linear regression analyses evaluated how teaching quality, classroom environment, and teacher-student interaction could predict student engagement, as these three independent variables were significant to student engagement. The statistical model is depicted in Figure 2.

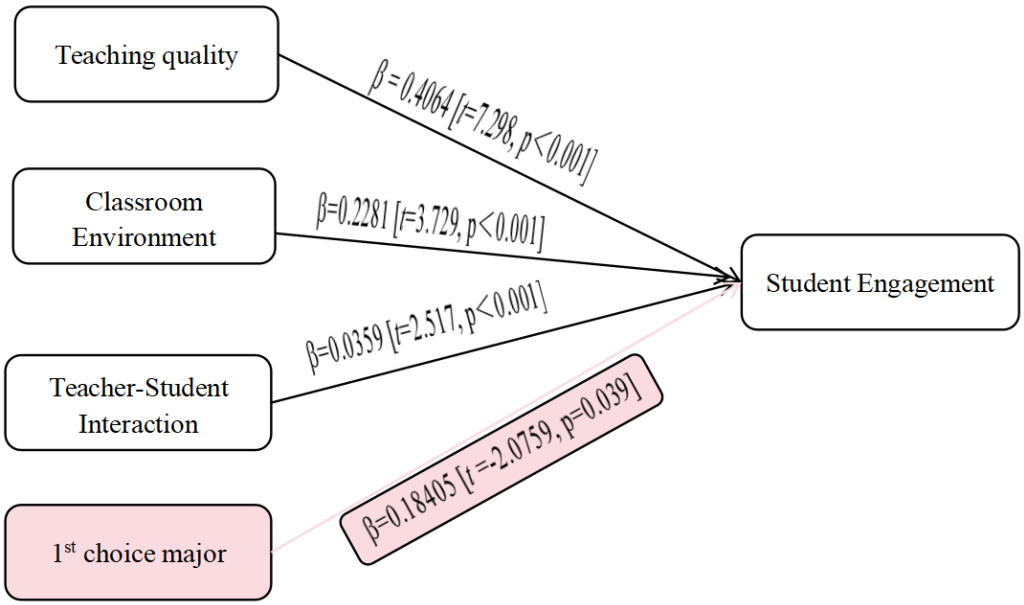

Figure 2: Model of Student Engagement for Engineering Students in Universities in Western Guangdong, China

The figure shows the beta coefficient, t-statistic, and p-values of the significant factors influencing engineering student engagement. The beta coefficient represents the degree of cha nge in the dependent variable for every unit of change in the independent variable. A larger va lue indicates a stronger effect on the dependent variable. The t-statistic confirms the statistical significance of the relationship. The larger the t-statistic value, the more significant the relatio nship between the independent and dependent variables. The p-value, set at 0.05 for this stud y, is the threshold for which significance is measured. If the results are less than 0.05, then the result is considered statistically significant.

Three influencing factors, Teaching Quality, Classroom Environment, and Teacher-Student Interaction, are significant in student engagement. For Teaching quality ($\beta = 0.4064$ [$t = 7.298$, $p < 0.001$]), this shows that Teaching Quality has the most significant influence on Student Engagement. The second factor, Classroom Environment ($\beta = 0.2281$ [$t = 3.729$, $p < 0.001$]), has the second largest effect on Student Engagement. The third factor, Teacher-Student Interaction ($\beta = 0.0359$ [$t = 2.517$, $p < 0.001$]), is significant but has the least effect on Student Engagement out of the three factors. The demographic or nominal variable of the First Choice of Major ($\beta = 0.18405$ [$t = -2.0759$, $p = 0.039$]) is also significant with Student Engagement. The beta coefficient is positive, meaning the students are more engaged if the engineering major is the first choice. However, if the engineering major is not the first choice, the level of engagement decreases.

Discussion

This study examined student engagement in three areas: behavioral, emotional, and cognitive engagement. Overall, student engagement levels among engineering students in Western Guangdong were high, with behavioral engagement being the highest and cognitive engagement being the lowest.

The study found that behavioral engagement had a high average score of 3.86. This indicates that students were highly engaged behaviorally, working hard to get good grades, completing homework on time, and actively participating in group assignments. Students showed high levels of self-discipline, attended classes regularly, participated in university activities, focused on lessons, listened to teachers carefully, and engaged in discussions with teachers and peers when they did not understand the material. Research by Gul et al. (2021) supports this, showing that students often engage behaviorally through class participation, discussions, and speaking activities.

Emotional engagement was the lowest among the three dimensions, as also observed in the research by Bedenlier et al. (2020), where emotional disengagement was common. Students showed lower emotional engagement because they desired more interactive and enjoyable class experiences. Many students wanted to discuss career plans and work with teachers beyond coursework. The lack of fun or interest in classes and teachers focusing mainly on course content contributed to this lower emotional engagement. For students to become more emotionally engaged, they need a positive academic and emotional state, which motivates them to participate actively in learning activities. However, creating lively classroom activities poses a challenge for university teachers in Western Guangdong.

Students demonstrated a higher level of cognitive engagement. They excelled at assignments requiring integrating ideas, applying course materials to real life, and reviewing class notes to understand materials better. This high cognitive engagement was attributed to students asking questions, discussing with peers, and collaborating on engineering problems. Activities like making concept maps and summarizing enhance cognitive engagement by encouraging students to connect ideas and build their understanding. Engaging in discussions

and collaborative projects further increases cognitive engagement by reflecting, questioning, and evaluating ideas (Wu & Rau, 2020; Zepke & Leach, 2010).

This study found that teacher-student interaction significantly impacts student engagement. This finding is consistent with previous research by Xerri and Shacklock (2018), who noted that positive teacher-student relationships enhance student engagement. McDonnell et al. (1998) found frequent academic interactions with teachers are linked to higher student engagement. Similarly, Nyadanu et al. (2015) reported that teacher-student relationships are significantly related to student engagement. In addition, Zhang et al. (2015) found that interaction between students and course tutors is especially critical for students' engagement at university.

The reasons for this can be viewed from two perspectives. For teachers, strong interactions with students lead to greater investment in their students and the use of strategies that encourage deeper learning, which enhances student engagement in academic activities. Positive interactions with teachers encourage students to ask more academic questions, receive more feedback, reduce anxiety, and lessen their workload. When teachers and administrators cultivate positive interactions, students are likelier to perform better and achieve desired outcomes, such as improved learning and skills. These findings highlight the importance of re-examining teacher-student interactions, including those related to students' academic, personal, or professional development (Teoh et al., 2013).

The findings of this study showed no significant relationship between student engagement and peer support. Although peer support is often considered important, this study's results indicated otherwise. This aligns with the research by Jackling and Natoli (2011), who also found no significant link between student-student support and student engagement among Australian university students. However, it contrasts with Hakimzadeh and Ghorban (2016), who found significant positive correlations between peer support and student engagement in academic activities.

A possible explanation for this result is that university students are already independent adults who make decisions based on their knowledge, interests, and values rather than the influence of their peers. University students may need less emotional and cognitive peer support than adolescents and do not rely on peer support to enhance their engagement and attitudes toward academic activities.

Personal motivation is typically considered an important factor in student engagement, but this study found otherwise. This finding contrasts with Singh and Bolar (2022), who identified student motivation as a key factor in student work engagement among university students. Similarly, Li et al. (2022) demonstrated that in online learning environments, autonomy-supportive teaching and student intrinsic motivation positively influence student engagement. Interestingly, they found that controlling teaching motivations and student extrinsic motivation did not significantly impact student engagement.

The discrepancy in this study's results may be due to the limited sample size and the specific population selected, which reduced the power to detect significant differences. Therefore, employing more detailed methods to measure the relationship between personal motivation and student engagement may be necessary. Future studies could enhance their approach by including additional measures that stimulate students' intrinsic motivation or related variables such as self-efficacy and self-regulation.

Suggestion

Based on the study results, several strategies are recommended to improve teaching quality, as it greatly affects student engagement. First, universities should set up systems to ensure teaching quality, helping to boost student engagement. This can include regular reviews of teaching methods and feedback systems where students can share their thoughts on teaching effectiveness. Teachers should also use more student-centered teaching strategies, allowing students to actively participate in the learning process, which can increase their engagement. Techniques like flipped classrooms, problem-based learning, and personalized learning plans can make learning more interesting and engaging for students. Teachers should design their lessons to involve all students in discussions, communication, and group learning activities, encouraging them to engage with the material and each other, which helps deepen their understanding. Encouraging group projects and peer teaching can further boost student involvement.

Additionally, several important areas should be addressed to improve teaching quality and increase student engagement. Ensuring the curriculum is up-to-date and connected to industry standards and practices makes learning more relevant and meaningful. Creating an interactive classroom environment where students feel comfortable asking questions, discussing ideas, and working on projects can be achieved through innovative classroom setups and technology. Teachers should have ongoing professional development opportunities to learn new teaching methods and tools to improve their effectiveness and student engagement. Regular feedback from students allows teachers to adjust their methods and improve their teaching. Teachers should also reflect on their teaching to continually improve their approach.

Enhancing classroom environments is particularly important for engaging engineering students, who can benefit from hands-on and interactive learning experiences. Engineering educators should create a classroom setting that encourages experimentation and problem-solving. This can be achieved by adding more lab work, project-based assignments, and real-world engineering challenges into the curriculum. Technology such as simulations and virtual labs can provide students with practical experience without needing physical equipment. Classrooms should be arranged to promote collaboration, with flexible seating arrangements encouraging group work and discussions. Teachers can also create a positive and inclusive classroom atmosphere by encouraging communication and allowing students to voice their ideas and ask questions. This approach helps students feel valued and more willing to participate actively in class.

Ways to enhance classroom environments for engineering students include more hands-on activities like building models or doing experiments that help students understand concepts better by applying them to real-world situations. Project-based learning encourages students to work on solving real engineering problems and helps them develop critical thinking and problem-solving skills. Integrating technology, such as computer simulations and virtual labs, gives students practical experience and helps them engagingly learn complex topics. Classrooms can be arranged to support group work, with flexible seating arrangements and spaces for team discussions that encourage collaboration and communication among students.

Inviting engineers from different fields to speak to students about work and real-life situations or organizing visits to engineering companies can help students connect classroom learning to real-life applications. Providing students with regular feedback on their work and encouraging them to share their thoughts on lessons can help teachers understand what is useful and needs improvement.

Enhancing teacher-student interaction is essential since it significantly influences student engagement. To achieve this, universities can organize freshman seminars and form discussion groups led by experienced faculty members. These initiatives help students feel more connected to their teachers and peers, gradually building a supportive learning environment. Encouraging the creation of "resource groups" where teachers and students collaborate can also be effective.

Teachers can increase student engagement by providing efficient and timely written or oral feedback on academic performance. Teachers should also recognize students' emotional needs and offer support and guidance. This can include extending a helping hand and sharing ideas to help students overcome challenges. Teachers should provide additional time emo, emotional support, and counseling for students who experience high levels of anxiety or psychological issues. This support can significantly boost students' engagement and help them feel more comfortable participating in class.

In addition to these strategies, teachers can hold regular office hours and encourage students to attend one-on-one discussions. Using online platforms for virtual meetings and Q&A sessions can also facilitate easier communication between teachers and students. Teachers can adjust their instruction to better meet student needs by learning about students' interests and goals. These approaches can encourage stronger connections between teachers and students.

The following recommendations are suggested for future studies on student engagement in universities and colleges. First, researchers should use larger sample sizes and conduct comparative studies across different types of higher education institutions to identify best practices and effective strategies for improving engineering student engagement. This approach would yield more accurate and actionable data. Second, further studies should propose models based on different disciplinary contexts, as these contexts have unique characteristics that can lead to different results. Third, future research may benefit from using various qualitative methods, such as interviews, group discussions, and observations, to analyze complex issues in student engagement more effectively.

Researchers should also consider factors like professional development and the professional environment to identify other influences on student engagement, especially within China's national context. Finally, future researchers might explore student engagement in the context of negative employment prospects to understand how such conditions affect engagement levels.

The limitations of this study include a few points. First, the study results may only apply to some students because the sample size is limited and only includes respondents from three universities in western Guangdong. This could affect the ability to detect significant relationships, especially between factors like peer support, personal motivation, and student engagement. Second, the findings focus on engineering students, so they differ from students in other fields. Third, the study used content analysis and literature review to identify important factors, which means the research method needed to be narrower.

Future research should consider the broader social and economic environment, use larger and more diverse samples, and apply various research methods to improve the generalizability and accuracy of the findings.

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