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# Assessment of Student Satisfaction with Dual Education in Educational Programs in Kazakhstan

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## ABSTRACT

Dual education, a hybrid model combining classroom learning with practical on-site training, is critical to vocational and technical education (TVET). Despite its widespread implementation, there are significant gaps in understanding how dual education influences student satisfaction. The primary objective of this study is to investigate the key factors influencing student satisfaction in Kazakhstan's dual education system, focusing on the impact of practical and theoretical training. This study adopted a quantitative approach, and data were collected from students enrolled in dual education programs across various educational institutions using a structured survey. The survey measured overall satisfaction and professional experience on a Likert scale. The analysis revealed that the practical component of dual education significantly increases student satisfaction by 42.3%, followed by theoretical training (35.1%) and professional experience (16.6%). The model explains 46.3% of the variance in overall student satisfaction. This suggests that practical and theoretical components are critical to enhancing student experiences in dual education programs. The findings highlight the need for further development in both practical and theoretical aspects of dual education to meet student and labor market needs. The study's implications are essential for improving vocational training programs, particularly aligning education with market expectations. The implications of our study can be instrumental in refining educational programs and aligning them with the needs of students and the labor market. Further research is necessary to explore the specific challenges different specializations face in dual education.

**KEYWORDS:** Education, Dual Education, Practical Training, Practical Education, Economic Integration, Labor Economics, Labor Mobility, Unemployment

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# Оценка удовлетворенности студентов дуальным обучением в образовательных программах Казахстана

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**АННОТАЦИЯ**

Дуальное образование, представляющее собой гибридную модель, которая сочетает в себе классное обучение с практической подготовкой на производстве, является важным компонентом системы профессионального и технического образования (СПТО). Несмотря на широкое внедрение дуальной системы, существуют значительные пробелы в понимании ее влияния на удовлетворенность студентов. Цель данного исследования заключается в анализе ключевых факторов, влияющих на удовлетворенность студентов дуальной системой образования в Казахстане, с акцентом на влияние практической и теоретической подготовки. В исследовании использован количественный подход, данные собирались с помощью структурированного опроса среди студентов, обучающихся по программам дуального образования в различных учебных заведениях. Опрос измерял общую удовлетворенность и профессиональный опыт по шкале Лайкерта. Анализ показал, что практическая составляющая дуального образования увеличивает удовлетворенность студентов на 42,3%, теоретическая подготовка — на 35,1%, а профессиональный опыт — на 16,6%. Модель объясняет 46,3% изменений в общей удовлетворенности студентов. Это свидетельствует о том, что как практические, так и теоретические компоненты критически важны для улучшения опыта студентов в дуальных образовательных программах. Выводы подчеркивают необходимость дальнейшего развития как практических, так и теоретических аспектов дуального обучения для удовлетворения потребностей студентов и рынка труда. Результаты исследования могут быть использованы для совершенствования программ профессионального обучения и их адаптации к требованиям рынка. Необходимы дальнейшие исследования для изучения специфических проблем, с которыми сталкиваются различные специальности в дуальной системе образования.

**КЛЮЧЕВЫЕ СЛОВА:** образование, дуальное образование, производственная практика, практическое образование, экономическая интеграция, экономика труда, мобильность рабочей силы, Безработица

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## INTRODUCTION

Dual education is one of the key models in the vocational education system. It aims to improve graduates' employment, thanks to the close integration of theoretical education with practical training on production sites. In Kazakhstan, the dual education model began to develop in 2012, which enabled the integration of educational processes and production practices within the educational programs of several technical and vocational education organizations (TVET). According to the principles of dual education, students spend part of their academic time in classrooms, mastering theory, and the rest of the time is devoted to forming and improving practical skills at enterprises and other production bases. However, despite more than a decade since its introduction, the dual education system in Kazakhstan still faces severe challenges in terms of its development.

TVET plays a crucial role in addressing youth unemployment and facilitating the transition of young people into the labor market. Recently, researchers have increasingly focused on the effectiveness of vocational education systems, driven by the need to adapt programs to modern economic conditions and labor market demands. This study reviews key issues, including TVET's role in youth transitions, challenges in implementing reforms, and the impact of globalization on labor markets. For example, Maier (2022) highlights the positive impact of vocational training on employment in Germany, where economic integration can both improve and complicate labor market conditions (Noelke, 2016).

Significant attention is given to the role of family involvement in motivating success in TVET. Additionally, policy measures taken in response to the COVID-19 pandemic and their effects on youth employment are analyzed, as highlighted by Eichhorst and Marx (2021). Studies by Schmid and Haukedal (2022) discussed social mobility and the challenges in developing the TVET system, emphasizing the need to update educational programs and introduce new learning approaches.

One of the primary challenges associated with the underdevelopment of the dual education system is the low quality of education within TVET institutions, a problem not unique to Kazakhstan but shared by other countries, and compounded by the social composition of students, many of whom come from disadvantaged backgrounds and demonstrate low academic achievement. As a result, graduates from such institutions often struggle to compete in the labor market.

Kazakhstani colleges face significant issues, including a lack of educational programs and insufficient practice-oriented disciplines, which are further exacerbated by the absence of modern learning approaches, such as competence-based programs aimed at developing professional skills. This situation significantly reduces students' chances of successful employment. Additionally, personnel issues in the TVET system present further challenges, as vocational school teachers receive relatively low salaries compared to their counterparts in general education, reducing their motivation to improve the quality of their work and hindering the development of their professional competencies, ultimately impacting students' training. Despite these problems, the dual education system is widely recognized as a practical learning model, successfully used in many countries to combat youth unemployment, allowing students to acquire professional skills during the learning process and significantly increasing their chances of employment after graduation.

Youth unemployment remains a significant social problem in Kazakhstan and many other countries. This issue became especially acute in the post-pandemic period when global economic changes aggravated the situation in the labor market. In Kazakhstan, the youth unemployment rate in 2022 was 7.2% for the 16-19 age group, 3.7% for 20-24 years and 4.5% for 25-29 years. At the same time, more than 88,000 young people aged 16-24 found themselves self-employed, which raises concerns about their economic stability and prospects in the labor market, especially in rural areas, where about 58% of the self-employed live (Doskeyeva, 2021; Bekenova, 2022).

The novelty of this study lies in analyzing the impact of the dual education system on the employment of young people in Kazakhstan, taking into account the specifics of the functioning of institutions of technical and vocational education (TVET). Unlike previous studies, the work provides a comparative analysis of students studying in the dual and traditional education systems, which allows us to identify differences in the level of students' confidence in their employment and their demand in the labor market. The study is based on data obtained during a survey of students from four colleges in Almaty and, for the first time, examines the interaction of dual education with social and economic factors affecting educational outcomes and further career prospects of graduates of TVET in Kazakhstan.

This study examines the dual education system's impact on increasing youth employment in Kazakhstan and analyzes the factors influencing the demand for TVET graduates in the labor market.

## LITERATURE REVIEW

Dual education in Kazakhstan started its development in 2012, and currently, some organizations TVET work under the rules of a dual learning system. According to curricula, one part of the student's study time takes place in the classrooms of the educational buildings. However, another part of their time is devoted to forming and improving practical skills at enterprises, companies, and other production bases.

The underdevelopment of Kazakhstan's dual education system mirrored global challenges in TVET. As higher education gained preference, TVET struggled to compete with bachelor's programs, and university graduates often overshadowed TVET graduates in the job market. Employers valued practical TVET skills and university-level analytical abilities, highlighting the need for hybrid educational models (Hippach-Schneider et al., 2013). Ling (2015) emphasized the relatively low status of technical and vocational institutions, particularly in developing countries like urban China, where TVET was often perceived as inferior due to less stringent teacher recruitment standards, reflecting broader challenges faced by vocational education systems, particularly in ensuring quality training and skilled educators. Ertl (2020) noted that in its efforts to increase youth participation in higher education from 34% to 40% by 2007, Germany witnessed a decline in TVET enrollment as more school leavers opted for higher education. The proportion of young people attending universities rose from 30.2% in 2000 to 53.9% in 2017, raising concerns about potential shortages of highly skilled labor as fewer youths pursued vocational training. More recently, Hautz and Thoma (2021) argued that improving the development and professionalism of TVET teachers could have significantly enhanced the quality of education within these institutions, potentially elevating the status and effectiveness of vocational education systems.

Regarding the TVET system in Kazakhstan, the current state indicates significant challenges that necessitate urgent improvement. One of the foremost issues is the quality of education provided. Unfortunately, many TVET institutions in the country fail to deliver the requisite level of education, highlighting a need to enhance the quality of learning. The deficiency is often attributed to the enrollment of students primarily from socially and economically disadvantaged backgrounds, who may have lower academic achievements (Suaphan, 2015; Wang & Guo, 2019).

Inadequate personnel policies and low teacher motivation hinder the quality of education in Kazakhstan's TVET institutions. TVET teachers earn less than their counterparts in general education, which discourages teaching quality improvements. Dutschke (2018) found that 77% of TVET teachers work on non-working days, indicating heavy workloads. Sirk et al. (2022) emphasized the need for professional collaboration to enhance teaching effectiveness, while Loo (2022) highlighted low pay and the stressful nature of vocational teaching globally.

Chesnut and Burley (2015) noted that while passion for the profession is important, financial motivation is essential for teachers' development. Poor teaching methods directly impact students' educational outcomes and their success in the labor market. The quality of TVET programs in Kazakhstan is also affected by curricula focused too heavily on theoretical education, with insufficient practice-oriented disciplines. Competence-based vocational education, as suggested by Misbah et al. (2020), is crucial for improving students' career readiness and success.

The student composition within TVET programs in Kazakhstan poses challenges, as many students come from disadvantaged academic backgrounds. High-achieving students often pursue higher education, while many TVET graduates struggle to secure employment, contributing to the rise of NEET (youth not in employment, education, or training). Choi et al. (2015) and Boonk et al. (2022) found that parental involvement significantly boosts academic achievement, but academic engagement within institutions is also key to student success.

Shi and Bangpan (2022) emphasized that TVET participants, especially from disadvantaged backgrounds, need substantial academic engagement to enhance their learning. They stressed the importance of a supportive social environment to develop socio-emotional skills and cultural capital. Despite disparities in educational quality, TVET institutions foster aspirations and growth for low-income students, offering stability that aids in academic and employment prospects. Achatz et al. (2022) highlighted "transition measures" that improve practical skills and help disadvantaged students become more competitive in the workforce.

Youth unemployment is a persistent global issue, with studies exploring its causes and solutions. Ghoshray et al. (2016) highlighted the steady rise in youth unemployment, especially in post-Soviet and European regions, with long-term social and economic consequences. Eichhorst et al. (2021) noted how the COVID-19 pandemic worsened this prob-

lem, while Allais (2022) found that dual education systems in TVET and higher education effectively address youth unemployment.

A comprehensive approach is required to combat this issue. Dutt et al. (2009) and Awad and Youssof (2017) emphasized the role of expanding trade and investment policies, while O'Reilly et al. (2015), Pastore (2017),Qasim and Mahmood (2022) advocated for educational reforms that develop work-related skills. Selenko and Pils (2019), and Speckesser et al. (2019) highlighted the positive impact of the Youth Guarantee and Active Labor Market Policy programs, which provided practical training. Piopiunik et al. (2020) and Doris et al. (2020) suggested adjusting unemployment benefits, while Qasim and Mahmood (2022) argued that education reforms tailored to labor market demands would reduce youth unemployment.

Conducted literature review depicted the importance of both theoretical training and practice of professional skills in the dual education system, as well as the quality of teaching and integration of practical skills. However, in the context of Kazakhstan, the specific impact of identified factors remains underexplored. The goal of current research is to fill this gap by investigating which aspects of the dual education system play a key role in shaping student satisfaction and how they can be improved to enhance the overall effectiveness of the system. Therefore, the following hypotheses were developed:

*Hypothesis 1.* Satisfaction with the practical component of dual education has a significant positive impact on overall satisfaction.

*Hypothesis 2.* Satisfaction with the theoretical component of dual education positively influences overall satisfaction.

*Hypothesis 3.* The level of professional experience gained during dual education positively affects overall satisfaction.

## METHODOLOGY

The current study investigates the factors influencing student satisfaction with dual education, focusing on the relationship between satisfaction with practical and theoretical components, professional experience, and overall satisfaction. Figure 1 illustrates the key determinants of satisfaction in dual education, analyzed using survey data within a quantitative research design.

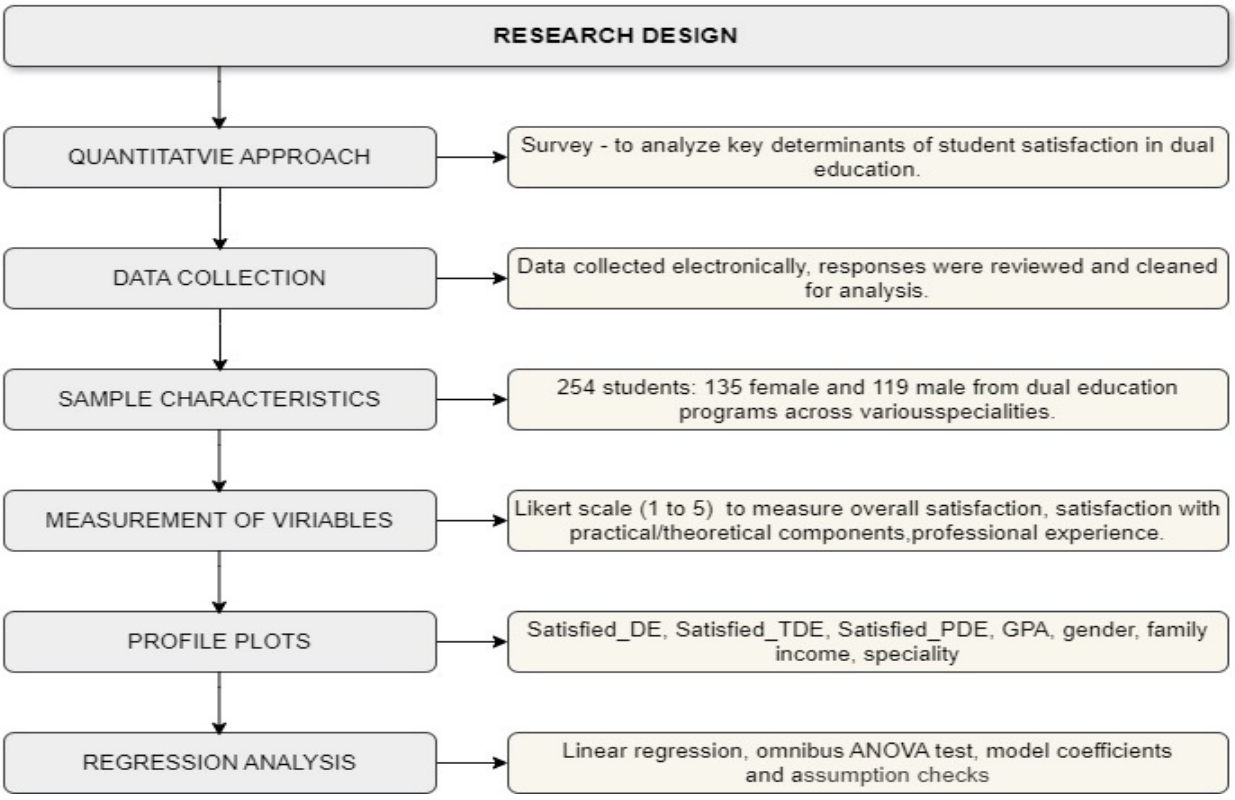


**Figure 1.** Research design

Note: compiled by the authors

A cross-sectional survey was conducted to collect data from students currently enrolled in dual education programs. The sample consisted of 254 students enrolled in dual education programs from different institutions and fields of study. The participants included students from various academic years, ensuring diverse representation within the dual education system. Essential demographic information such as gender, age, and year of study was collected but was not the primary focus of the analysis.

To examine factors influencing student satisfaction, the survey used a Likert scale (1 = very dissatisfied to 5 = very satisfied) to measure:

Overall satisfaction with dual education (Satisfied_DE) variable measured students' general satisfaction with their dual education experience.

Satisfaction with the practical component (Satisfied_PDE) variable measured students' satisfaction with the work-based component of their education, assessing how well practical training met their expectations and prepared them for their future careers.

Satisfaction with the theoretical component (Satisfied_TDE) variable measures students' satisfaction with the theoretical part of their education to understand how well theoretical content complements practical training.

The extent of Professional experience related experience gained during the dual education program was measured.

A multiple linear regression analysis was conducted to test the hypotheses using JAMOVI softare. The regression model aimed to evaluate the effect of three independent variables—satisfaction with the practical component (Satisfied_PDE), satisfaction with the theoretical component (Satisfied_TDE), and professional experience - on the dependent variable, overall satisfaction with dual education (Satisfied_DE). The regression model included all predictors simultaneously to assess their relative influence on overall satisfaction.

## ANALYSIS AND RESULTS

The research structure includes an analysis of the relationship between student satisfaction with dual education and various specialties. The focus was to explore how satisfaction with dual education's practical and theoretical components influences student satisfaction with the study program. By comparing these satisfaction measures across different fields a significant subjects, the goal was to identify trends, patterns, and variations in how students perceive the value of theoretical knowledge and practical experience in educational outcomes.

Figure 2 describes the satisfaction with dual education (Satisfied_DE) is displayed by gender across various specializations. The charts represent the spread of satisfaction levels between male and female students (where 1.0 represents male and 2.0 represents female) for each program.

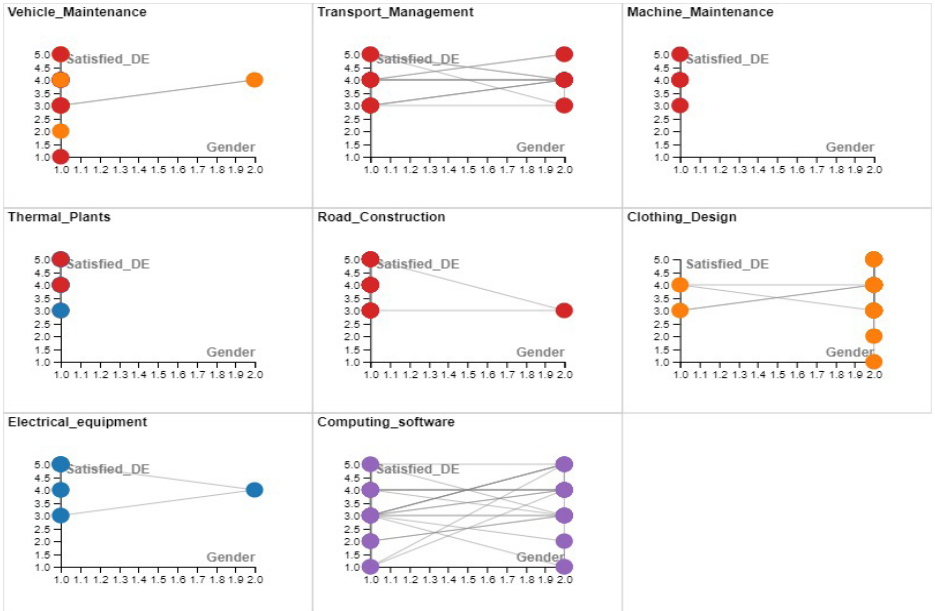


**Figure 2.** Satisfaction with dual education by gender across various specializations.

Note: compiled by the authors

In several specializations, such as Vehicle Maintenance, Road Construction, and Machine Maintenance, there was a noticeable difference in satisfaction between male and female students. For example, in *V*ehicle Maintenance, female students reported higher satisfaction levels compared to their male counterparts. Female students may find the dual education system more beneficial in some fields, while male students may not experience the same level of satisfaction. In contrast, in programs like Transport Management and Thermal Plants, there was less variation in satisfaction between genders, with both male and female students showing similar levels of satisfaction. In Computing Software, both male and female students exhibited a wide range of satisfaction levels, reflecting a more diverse experience. Different expectations or variations in practical training experiences likely contributed to this, as the dual education model produces diverse outcomes based on students' professional backgrounds. Specializations like Clothing Design showed a more balanced satisfaction across genders, but with a slight edge toward female students, possibly due to the relevance of practical skills in this field. Female students may feel more connected to the dual education system through their practical training experiences.

Overall, gender influences satisfaction with dual education, but the extent varies across specializations. In some fields, like Vehicle Maintenance and Clothing Design, female students report higher satisfaction, while in others, like Transport Management, gender differences are less pronounced.

Figure 3 displays the distribution of satisfaction with dual education in relation to academic performance across different specializations.

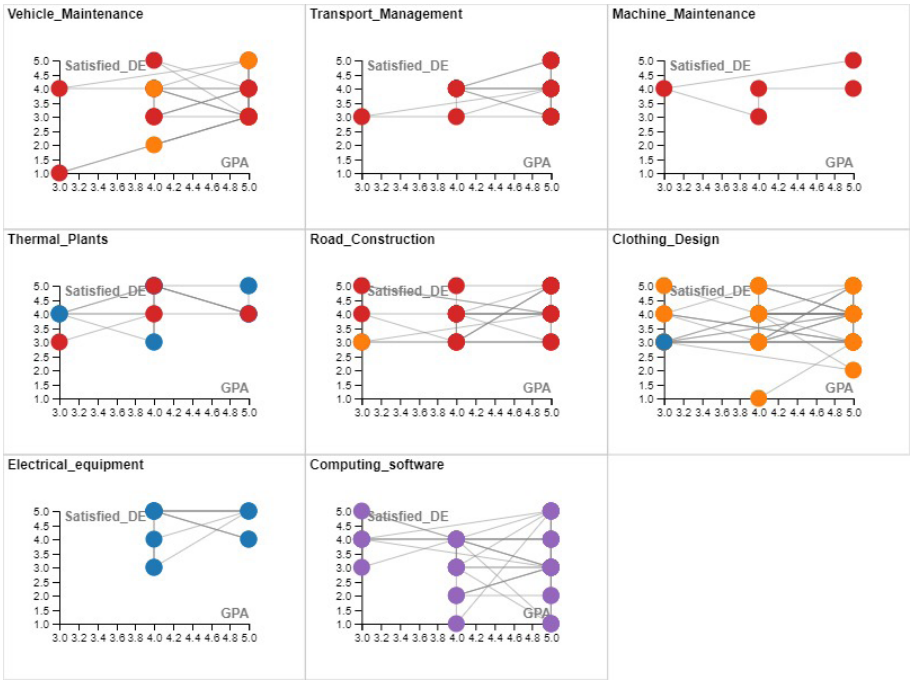


**Figure 3.** Satisfaction with dual education by academic performance across various specializations

Note: compiled by the authors

In most specializations, such as Vehicle Maintenance, Machine Maintenance, and Transport Management, a positive correlation can be observed between GPA and satisfaction with dual education, students with higher academic performance tend to be more satisfied with the dual education system, indicating that academic success may contribute to a more positive perception of this educational approach. However, this trend is not consistent across all specializations.

For example, there is no clear correlation between Clothing Design and Thermal Plants. Students with varying GPA levels exhibit similar levels of satisfaction with dual education in these fields, implying that other factors, such as practical skills or course workload, play a more significant role in

shaping students' opinions of the educational process in these areas.

The chart for Computing Software is particularly notable, as it shows a wide range of satisfaction levels across different GPA scores, thus students in this specialization have a more diverse evaluation of the dual education program, possibly due to differing expectations or variations in the quality of practical training provided. The bubble size, which may represent the number of students in each group, indicates that larger groups tend to show more averaged results, while smaller groups display more scattered data. For instance, in Road Construction, the bubble size shows a more concentrated distribution of opinions, which might suggest more consistent perceptions of the program among students.

Overall, the results indicate that satisfaction with dual education is somewhat linked to GPA, but this relationship varies by specialization. Some fields show a clear positive association, while others present a more diverse range of student opinions.

Figure 4 displays the relationship between students 'satisfaction with dual education and their family members' average income across various specializations. Thus, it highlights how students from different income backgrounds perceive dual education and whether financial standing might influence their satisfaction levels.

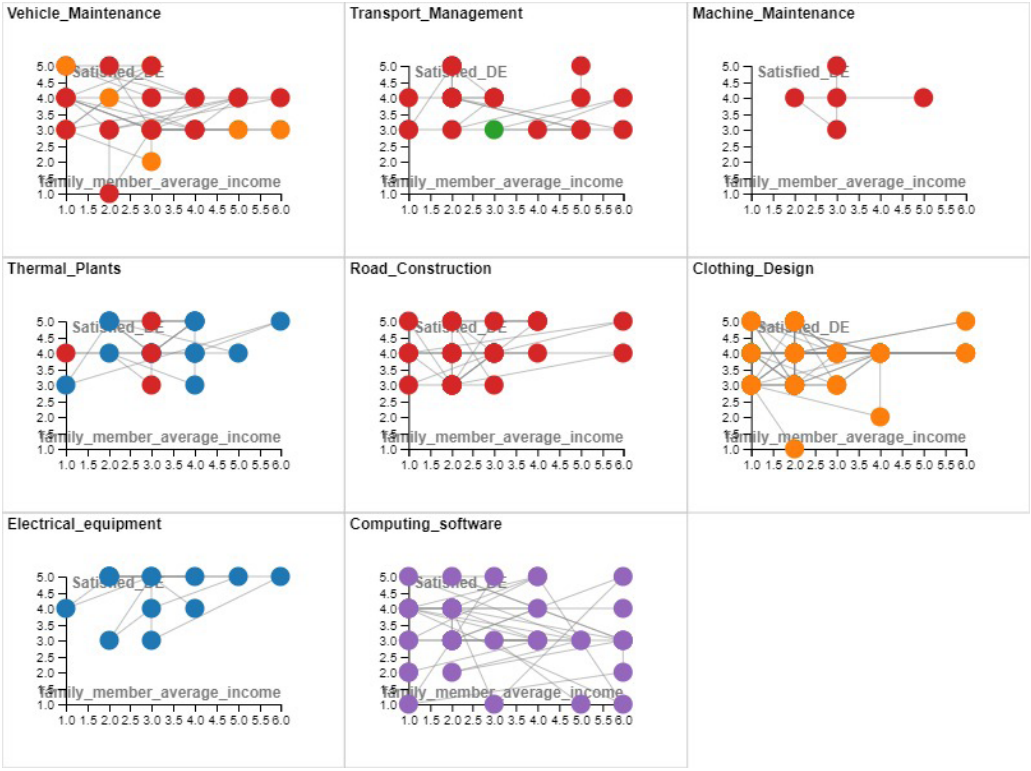


**Figure 4.** Satisfaction of students with dual education by their family members average income across various specializations

Note: compiled by the authors

In specializations like Vehicle Maintenance, Thermal Plants, and Road Construction, satisfaction levels remained consistent across different income groups. Family income did not significantly impact students' perceptions of the dual education system, with students from both lower- and higher-income families reporting similar levels of satisfaction. The practical value of education in these fields was appreciated regardless of financial background.

In contrast, specializations like Clothing Design showed a slight trend where students from higher-income families reported marginally higher satisfaction levels. Wealthier students may have had better access to resources or practical training opportunities, enhancing their overall experience. In Transport Management, the relationship between income and satisfaction was more scattered, with factors such as internship quality or personal

career expectations possibly influencing satisfaction levels. In Computing Software and Electrical Equipment, satisfaction levels were widely distributed across income groups, reflecting variability in the dual education experience in these fields.

Overall, family income did not have a strong effect on satisfaction with dual education across most specializations. While minor trends were observed in fields like Clothing Design and Transport Management, the differences were not pronounced. Factors such as the quality of internships or alignment with career goals likely played a more significant role in shaping students' satisfaction with their dual education experience.

Figure 5 displays the relationship between overall satisfaction with dual education (Satisfied_DE) and satisfaction with the theoretical component of dual education (Satisfied_TDE) across different specializations.

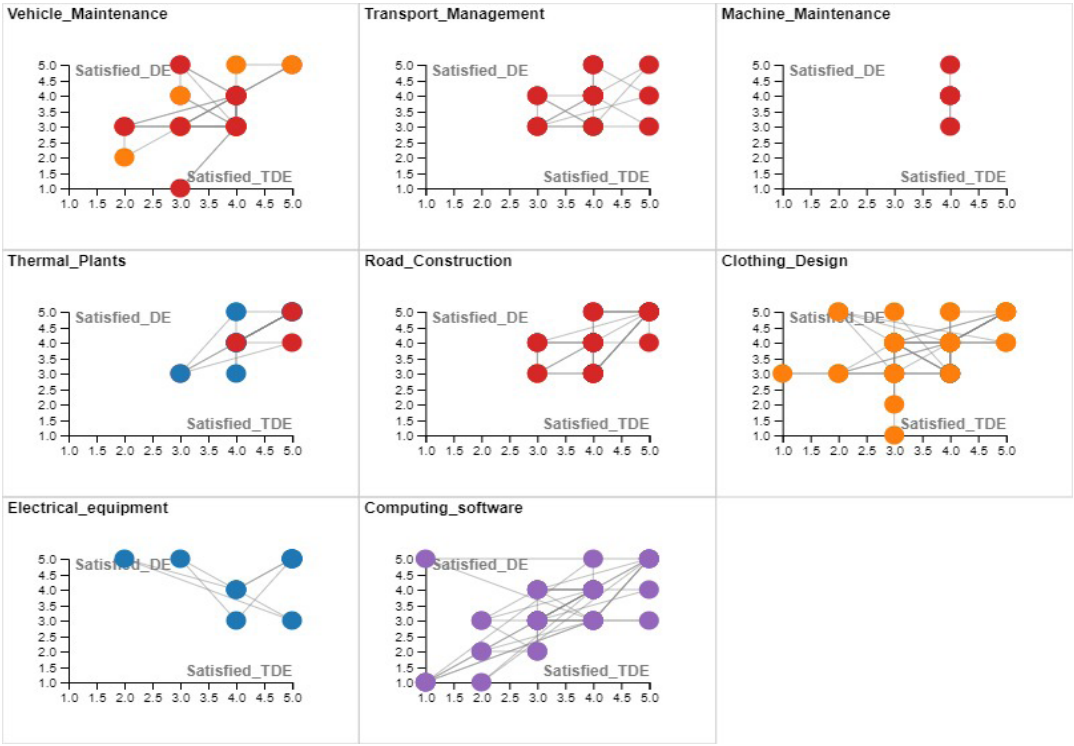


**Figure 5.** Satisfaction of students with dual education by satisfaction with the theoretical component of dual education across various specializations.

Note: compiled by the authors

In several fields, such as Vehicle Maintenance, Road Construction, and Clothing Design, there is a relatively strong alignment between overall satisfaction and satisfaction with the theoretical component of dual education. For students in these specializations, the theoretical part of the dual education program plays a significant role in shaping their overall positive perception. Students who are satisfied with the theoretical education provided as part of the dual system tend to report high overall satisfaction. Theoretical content is well-integrated and relevant to students' learning experiences in these fields.

In contrast, specializations such as Electrical Equipment and Thermal Plants show a more varied relationship between overall satisfaction and satisfaction with the theoretical component. In these areas, students' overall satisfaction with dual education does not consistently match their satisfaction with the theoretical component, suggesting that other factors—such as practical training—may substantially influence their overall experience. The discrepancies between the two satisfaction measures may indicate that, in these fields, the theoretical aspect does not align as closely with students' expec-

tations or practical needs. The results in Computing Software also show a wide range of overall and theoretical satisfaction levels, with less consistency between the two measures. Students in this subject placed differing levels of importance on the theoretical component, depending on their individual career goals and expectations.

The relationship between overall satisfaction and satisfaction with the theoretical component varies across specializations. In some fields, the theoretical aspect seems to be a key contributor to students' overall positive experience with dual education. In contrast, there may be a disconnect between the theoretical and practical elements in other fields. Further analysis of the practical component could provide additional insights into how these elements interact to shape students' overall satisfaction with dual education programs.

Figure 6 displays the relationship between overall satisfaction with dual education (Satisfied_DE) and satisfaction with the practical component of dual education (Satisfied_PDE) across various specializations.

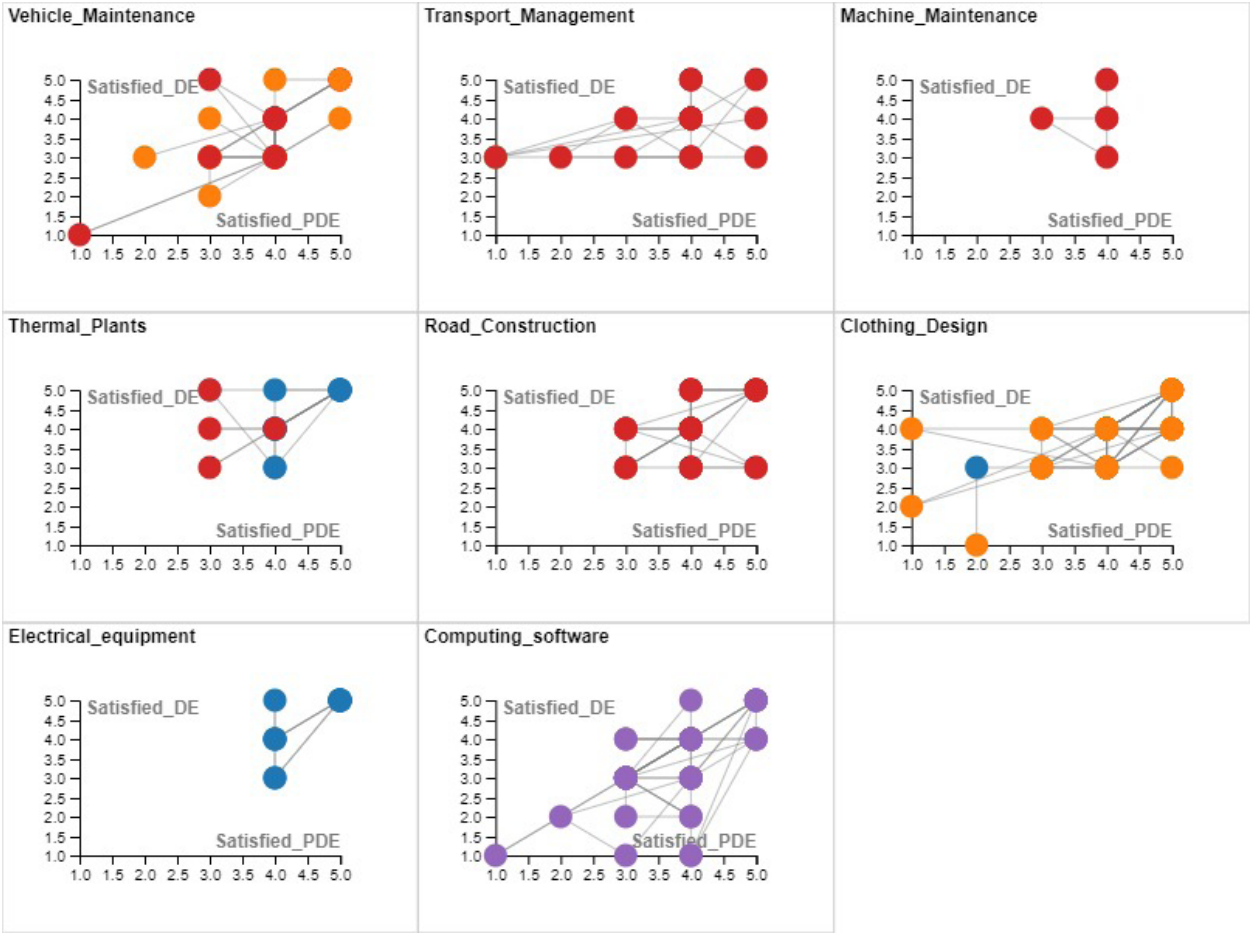


**Figure 6.** Satisfaction of students with dual education by satisfaction with the practical component of dual education across various specializations.

Note: compiled by the authors

In most specializations, such as Vehicle Maintenance and Road Construction, satisfaction with the practical component closely aligned with overall satisfaction. Students who were more satisfied with hands-on experiences tended to report higher overall satisfaction, emphasizing the importance of practical training in preparing for future careers. However, in fields like Electrical Equipment and Thermal Plants, the relationship between practical satisfaction and overall satisfaction varied, with other factors, such as theoretical education, influencing perceptions.

In Clothing Design and Computing Software, satisfaction levels with practical components and overall satisfaction were more scattered. In Clothing Design, this may reflect the quality of internships or career relevance, while in Computing Software, differences in how practical training was applied or integrated into the curriculum may have influenced satisfaction. Overall, practical satisfaction aligned more closely with overall satisfaction in fields where hands-on experience was directly relevant to careers, though in technical fields like Electrical Equipment and Thermal Plants, other factors also played a role.

When comparing satisfaction with the theoretical component and the practical component across different specializations, distinct patterns emerged. In technical fields such as Vehicle Maintenance and Road Construction, students valued both the theoretical and practical aspects equally, with both components contributing significantly to their overall satisfaction. However, in fields like Electrical Equipment and Thermal Plants, practical training appeared to have a stronger influence on satisfaction, while the theoretical component played a less central role in shaping students' perceptions.

The analysis showed that practical experience was a key driver of satisfaction in technical fields, while the influence of the theoretical component varied by specialization. In fields like Computing Software, both components contributed to satisfaction, though practical training had a slightly stronger impact. In Machine Maintenance, both were valued equally, indicating a more balanced experience. Overall, practical experiences tended to have a stronger influence on satisfaction, particularly in technical and hands-on specializations, emphasizing the need for dual education programs to effectively integrate both theoretical and practical elements to meet students' expectations.

A linear regression analysis examined how satisfaction with the practical and theoretical components of dual education and professional experience influences overall satisfaction with dual education (Satisfied_DE). The following tables summarize the regression model results, including the model fit, significance of predictors, and assumption checks.

Table 2 shows the results for model fitness are presented.

**Table 1**. Linear regression model fit

| Model | R | $R^2$ | Adjusted $R^2$ | Overall Model Test | | | |
|---|---|---|---|---|---|---|---|
| | | | | F | df1 | df2 | p |
| 1 | 0.680 | 0.463 | 0.456 | 68.0 | 3 | 237 | < .001 |

Note: compiled by the authors

The results for the overall fit of the regression model showed that based on the $R^2 = 0.463$, indicated that approximately 46.3% of the variations or change in overall satisfaction with dual education (Satisfied_DE) is explained by the predictors: satisfaction with the practical component (Satisfied_PDE), satisfaction with the theoretical component (Satisfied_TDE), and professional experience. The F-statistic of 68.0 confirms that the model is statistically significant with a p-value of less than 0.001, which denotes that at least one of the predictors is significantly associated with overall satisfaction.

Table 1 shows the results of the Omnibus ANOVA test are presented.

**Table 2.** Omnibus ANOVA test

| Variable | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Satisfied_PDE | 24.61 | 1 | 24.609 | 55.1 | < .001 |
| Satisfied_TDE | 18.33 | 1 | 18.329 | 41.0 | < .001 |
| Professional_experiance | 4.66 | 1 | 4.664 | 10.4 | 0.001 |
| Residuals | 105.88 | 237 | 0.447 | | |

Note: compiled by the authors

The Omnibus ANOVA results showed how each predictor contributed to the overall model. Satisfaction with the practical component (Satisfied_PDE) explains a significant portion of the variance in overall satisfaction, with an F-statistic of 55.1 and a p-value of less than 0.001. Satisfaction with the

theoretical component (Satisfied_TDE) also contributes significantly, with an F-statistic of 41.0 and a p-value of less than 0.001. Finally, professional experience has a more minor yet significant impact, with an F-statistic of 10.4 and a p-value of 0.001. The residual sum of squares is 105.88, reflecting the unexplained variance in the model.

To sum up, the p-value for all variables is less than alpha 0,05 and confirms the significant impact of all variables.

Next, in table 3, the results for model coefficients are presented.

**Table 3.** Model coefficients and assumption checks - Satisfied_DE

| Variable | Estimate | SE | t | p | VIF | Tolerance |
|---|---|---|---|---|---|---|
| Satisfied_PDE | 0.292 | 0.2529 | 1.15 | 0.249 | 1.27 | 0.790 |
| Satisfied_TDE | 0.423 | 0.0570 | 7.42 | <.001 | 1.25 | 0.797 |
| Professional_experiance | 0.351 | 0.0548 | 6.41 | <.001 | 1.05 | 0.954 |
| Residuals | 0.166 | 0.0515 | 3.23 | 0.001 | - | - |

Note: compiled by the authors

The results for model coefficients showed that the intercept is 0.292, though it is not statistically significant ($p = 0.249$). The Satisfied_PDE coefficient is 0.423, which means that for every unit increase in satisfaction with the practical component, overall satisfaction increases by 0.423 units. This effect is statistically significant, as shown by a p-value of less than 0.001. Similarly, Satisfied_TDE has a positive and significant coefficient of 0.351 ($p < 0.001$), indicating that higher satisfaction with the theoretical component also leads to higher overall satisfaction. Lastly, professional experience has a more minor but still significant effect, with a coefficient of 0.166 and a p-value of 0.001, suggesting that professional experience positively impacts overall satisfaction, albeit to a lesser extent than the satisfaction components. The VIF values for all predictors are below the accepted threshold of 10, suggesting that the predictors are independent and do not excessively correlate with each other. Corresponding tolerance values are above the threshold of 0.1, confirming the absence of multicollinearity issues.

## CONCLUSIONS

The primary aim of this study was to explore the factors that influence student satisfaction with dual education, specifically examining how satisfaction with the practical and theoretical components and professional experience contribute to overall satisfaction. The hypotheses proposed that satisfaction with the practical component (H1), the theoretical component (H2), and the level of professional experience (H3) would all have significant positive effects on overall satisfaction with dual education.

The results of the regression analysis confirmed these hypotheses. Satisfaction with the practical component was found to have the most decisive influence on overall satisfaction, followed closely by satisfaction with the theoretical component. Professional experience also played a significant role, although its impact was slightly weaker than the other two predictors. Together, these factors explained nearly half of the variance in overall satisfaction, indicating that students' perceptions of both practical and theoretical training and professional skill development are critical determinants of their overall satisfaction with dual education.

The graphical analysis provided further insights into these findings. Sankey diagrams revealed that students reported high satisfaction with their dual education experience and significant professional skill development in vehicle maintenance and clothing design fields. These fields effectively balanced practical and theoretical training, leading to higher satisfaction levels. On the other hand, specializations like Computing Software and Transport Management displayed more variability in satisfaction, suggesting that the dual education system in these fields may not fully align with students' expectations or industry needs. Additionally, technical fields like Machine Maintenance and Electrical Equipment showed thinner flows toward higher satisfaction levels, indicating potential gaps in professional skill development and the overall alignment of the program with career readiness.

Based on these findings, several recommendations can be made to enhance the effectiveness of dual education programs. First, emphasis should be placed on strengthening the practical training components, particularly in fields where satisfaction and professional skill development are lower. Ensuring the practical experience is closely aligned with industry standards and student career goals will likely improve satisfaction and prepare students for employment. Second, continuous evaluation and improvement of the theoretical component should be maintained, ensuring that it complements the

practical training and contributes meaningfully to students' professional growth. Lastly, more attention should be given to bridging the gap in technical fields, where students may feel less prepared for the workforce due to insufficient professional experience. Providing targeted support, improved mentorship opportunities and industry-relevant training could help address these concerns.

In conclusion, the study confirms that practical and theoretical satisfaction and professional experience are crucial to student satisfaction in dual education programs. However, to maximize the effectiveness of these programs, ongoing adjustments and improvements should be made, particularly in fields where gaps in professional skill development and satisfaction exist.

## AUTHORS CONTRIBUTION

Conceptualization and theory: GD; research design: GD; data collection: RK; analysis and interpretation: GD and RK; writing draft: GD and RK; supervision: GD; correction of article: GD and RK; proofread and final approval of article GD and RK. All authors have read and agreed to the published version of the manuscript.

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