

SUPPORTING DIVERSITY IN CIVIL ENGINEERING EDUCATION: EXPERIENCES OF STUDENTS WITH VOCATIONAL AND ACADEMIC BACKGROUNDS

Malena THOMASSEN, Anette NORHEIMDAL and Ingrid LANDE

University of Agder, Norway

ABSTRACT

This paper investigates how students with diverse backgrounds experience the Civil Engineer Education at University of Agder (UiA), Norway. Students are being recruited based on vocational qualifications or qualified directly through upper secondary school. One of UiA's focus areas has been to create different entries for various student groups to provide more people with the opportunity to pursue higher education. This creates diversity within the student group, contributing valuable perspectives and competencies to the learning and teaching environment. At the same time, experiences show that students face different challenges. Those with a vocational background often possess strong practical skills but may encounter greater difficulties with theoretical subjects. In contrast, individuals from an academic upper secondary school generally master the theoretical aspects more easily yet often lack practical experience. Additionally, vocationally qualified students are frequently in different life situations, being more established and older compared to peers coming directly from upper secondary school. The study aims to map how these different backgrounds affect students' experiences regarding priorities, and overall satisfaction with the programme. The focus will be on exploring how to support students with a vocational background to stay in the programme and completing their degree, including their views on which elements should be expanded, and which should be reduced. Data will be collected through a survey, and the results are expected to provide insights into how the programme can be adapted to support diversity and enhance learning outcomes for all student groups.

Keywords: Vocational background, learning environment, survey, civil engineering education

1 INTRODUCTION

The Norwegian government wants more focus on practical and experience-based competence in engineering education [1]. There is currently lack of qualified workforce in the fields of science, technology, engineering, and mathematics (STEM) [2], and this is a growing concern internationally, often referred to as a 'STEM crisis' [3]. Despite strong recruitment to these fields, the dropout rate is high. A study conducted by Yi Ding et al. [4] estimate that approximately 50% of students who start a bachelor's degree in STEM either drop out or change their field of study. From 2018 to 2021, only about 50% of engineering students in Norway completed their studies within the nominal time [5]. The problem is particularly pronounced in engineering education, where as many as 41% of students leave the programme during the first year [4]. To address this crisis, it is crucial to understand the factors that influence students' success and persistence.

A central theory for understanding students' adaptation is Holland's theory of vocational personality types [6]. Research [4] shows that a large proportion of engineering students, nearly 40%, identify with the Realistic (R) personality type. These students are often described as 'doers' who prefer practical, hands-on work with physical objects rather than theoretical ideas. While practical aptitude is essential for an engineer, studies show a negative correlation between a realistic personality type and academic grade point average (GPA). A plausible explanation is that university assessment methods are often heavily theoretical and analytical, meaning that students with a practical orientation are not given the opportunity to demonstrate their competence through traditional written examinations.

The challenges are further intensified for students who come from a vocational background, often referred to as TVET (Technical and Vocational Education and Training) [7]. Although these students initially seek practical competence, their educational pathways are often characterised by a lack of

resources, equipment, and skills training. Many end up as passive observers rather than active participants in practical instruction. When these students encounter the university's theoretical demands, combined with academic difficulties in core subjects such as mathematics and physics, the risk of dropout increases considerably.

Students in the civil engineering programme at University of Agder (UiA) are recruited either through vocational qualifications or directly from upper secondary school. UiA has introduced multiple admission pathways to increase access to higher education, resulting in a diverse student group with different strengths and needs. Because students from the vocational pathway often take different introductory subjects, first-year study groups are typically formed based on admission routes, which leads students to collaborate mainly within their own pathway and reduces opportunities to benefit from each other's complementary competencies. The study aims to examine how these differing backgrounds and life situations influence students' experiences, academic priorities, and overall satisfaction with the programme. The goal is to identify how the programme can better support students with vocational background, both academically and socially, and how the diverse competencies within the cohort can be used more effectively to improve learning outcomes for all.

2 METHODOLOGIES

The method used in this study was a survey conducted with the programme SurveyXact. The target group consisted of active students enrolled in the three-year bachelor's degree programme in civil engineering. The survey was distributed through the learning platform used at the University of Agder. Students may be admitted to the programme through three different pathways: the V-path (for applicants with a vocational certificate), TRES (for applicants lacking mathematics/physics competency from upper secondary school), or direct admission from upper secondary school (SO). The survey differentiates between these admission routes, as well as the extent of relevant practical experience the students possess. This study focuses on V-path and SO-path students, as the SO pathway represents the standard entry route to engineering programmes. TRES students are broadly comparable to SO students in terms of age and educational background; however, to enable a clearer comparison between more distinct groups, they were excluded from the analysis. In the survey, students were asked about their experiences with the study programme, including what they would like to have more or less of, and their overall satisfaction with the programme. In addition, the survey included three open-ended questions where students could provide further comments. A total of 80 students completed the entire survey, while 5 students did not finish the final question, and additional 6 students did not finish the two last questions. In total, 232 students received the survey, resulting in a total response rate of 35%. The survey remained open for 48 days (October 16th – December 3rd). Table 1 shows the number of respondents.

Table 1. Overview respondents

Respondents	Number
SO-path	43
V-path	23
TRES-path	24
Other	1
Total	91

Quantitative data were analysed using descriptive statistics; no further statistical analyses were conducted. Qualitative data were analysed using a thematic, interpretive approach; responses were reviewed manually, and excerpts were selected based on their ability to illustrate recurring themes, serving as illustrative rather than exhaustive examples.

3 RESULTS AND DISCUSSION

The results from the survey show that students with a vocational background and students admitted through SO have different strengths and face different challenges related to practical and theoretical subjects. Among V-path students a majority have substantial relevant work experience. Specifically, 26% report having 5-10 years of relevant practical experience, while 35% report more than 10 years. In comparison, 74% of SO students report having no relevant practical experience. These differences are reflected to some extent in how students experience various subjects, as can be seen in Figure 1. In a first-year subject, where practical experience with drawings, construction, and building assemblies may

be advantageous, only 5% of V-path students report finding the subject difficult or very difficult, compared to 18% of students admitted through SO. Similarly, 20% of V-path students describe a second-year subject considering how buildings interact with outdoor and indoor climates as easy or very easy, compared to only 5% among SO students. This indicates that practical experience may provide an advantage in subjects more closely related to construction practice, as opposed to mathematically oriented subjects. Several V-path students also report that such subjects are perceived as meaningful and relevant, which may contribute to increased motivation and engagement in the programme. V-path students are often characterised by a Realistic personality type [4], which may help explain why they find construction-related subjects easier than more theory-heavy subjects. Even when these subjects do not involve hands-on practical problem-solving, students may draw on their prior practical experience to contextualise and explain the theoretical concepts they encounter. Such subjects may therefore also function as an arena where students can integrate practical knowledge with academic theory, supporting both understanding and persistence in the programme. This may give the V-path students the possibility to share their knowledge instead of being a passive observer as stated by Mtshali [7]. By taking a more active role in the class, the students may be able to bridge the gap between the theoretical students, and the practical ones and help each other, reducing the likelihood of dropouts.

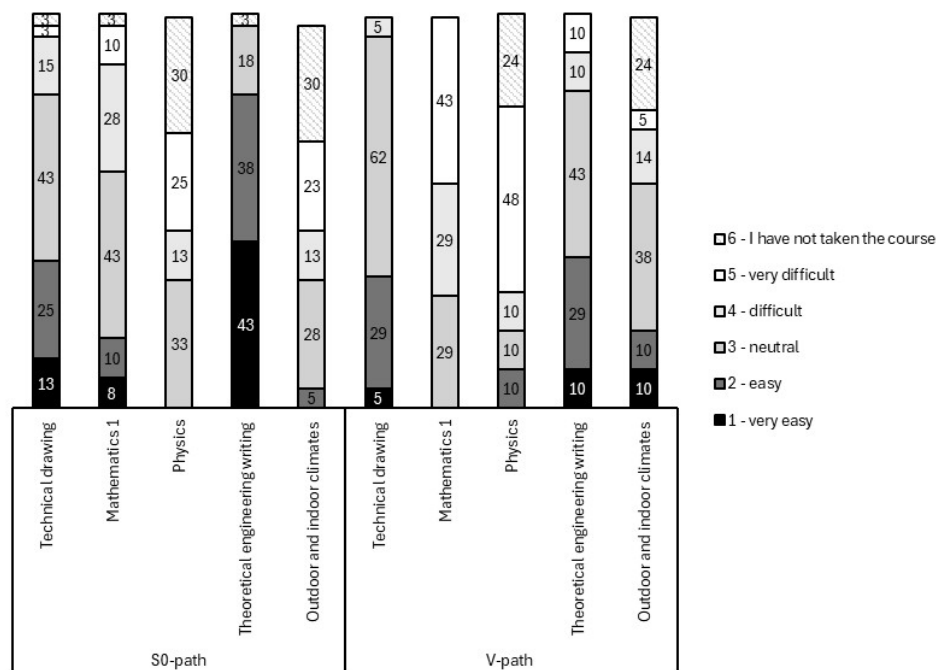


Figure 1. Response distribution in % regarding the perceived difficulty of the courses. Some courses are included in the figure based on the selection used in the analysis.

In more theoretically demanding subjects, however, the challenges faced by V-path students become more apparent. In Mathematics 1, as many as 72% of V-path students report the subject as difficult or very difficult, compared to 38% of SO students. A similar pattern is found in Physics, a subject characterised by a high degree of abstraction and theoretical reasoning, where 48% of V-path students describe the subject as very difficult, compared to 25% among students admitted through SO. Conversely, the results show that students from SO generally master theoretical skills to a greater extent, which reflects descriptions of Realistic personality types as struggling more with abstract theoretical levels compared to other personality types. In the theoretical engineering writing subject, 81% of SO students describe the subject as very easy or easy, and none report it as difficult. Among V-path students, however, 20% find this subject difficult or very difficult. This suggests that the transition from practical work to academic, abstract learning still represents a barrier for V-path students, despite dedicated admission pathways. This also underscores the research done by Ding et al. [4], who concludes that Realistic students (V-path) negatively correlate with GPA and struggle with the current assessment methods. At the same time, this may help explain why V-path students more frequently request support in the form of guidance, exercise sessions, and collaborative learning.

Differences in academic experiences must also be understood in light of students' life situations. There are clear differences in age and overall life circumstances between the two groups. Among V-path students, 57% are over the age of 26, compared to 19% of SO students. This indicates that V-path students are often more mature students with prior work experience. They tend to be more used to structured workdays and fixed working hours. Regarding housing and family situation, 30% of V-path students live alone or in shared housing with friends, while the rest are established with families. Among SO students, 61% live alone or in shared housing, while a smaller proportion have family responsibilities. This confirms that V-path students report spending more than 40 hours per week on their studies, compared to 23% of SO students. This may indicate that V-path students need to invest more time to cope with academic demands, particularly in theoretical subjects, while at the same time having less flexibility in their daily lives. These structural conditions also appear to influence students' satisfaction with the programme (Figure 2). Some differences are observed between the groups regarding overall satisfaction. Among V-path students, 53% report being satisfied or very satisfied with the programme, while 37% report being neutral. Students admitted through SO report higher satisfaction with the programme itself, with 71% being satisfied or very satisfied and only 20% reporting neutral satisfaction. This may have several explanations. V-path students are required to attend more scheduled teaching activities due to their academic background. SO students report that they find academic content easier to manage and have greater flexibility in their schedules. In contrast, V-path students are accustomed to fixed working hours, and evening lectures may therefore be challenging in relation to family life. In addition, students admitted through SO are generally more familiar with school-based tasks, as the majority enter directly from upper secondary school, making the transition to higher education easier. However, satisfaction with the learning environment is lower among SO students, with 63% reporting being satisfied or very satisfied. At the same time, as many as of V-path students 84% are satisfied or very satisfied with the learning environment. This suggests that although many V-path students experience academic challenges, they perceive the social and learning environment as overall positive.

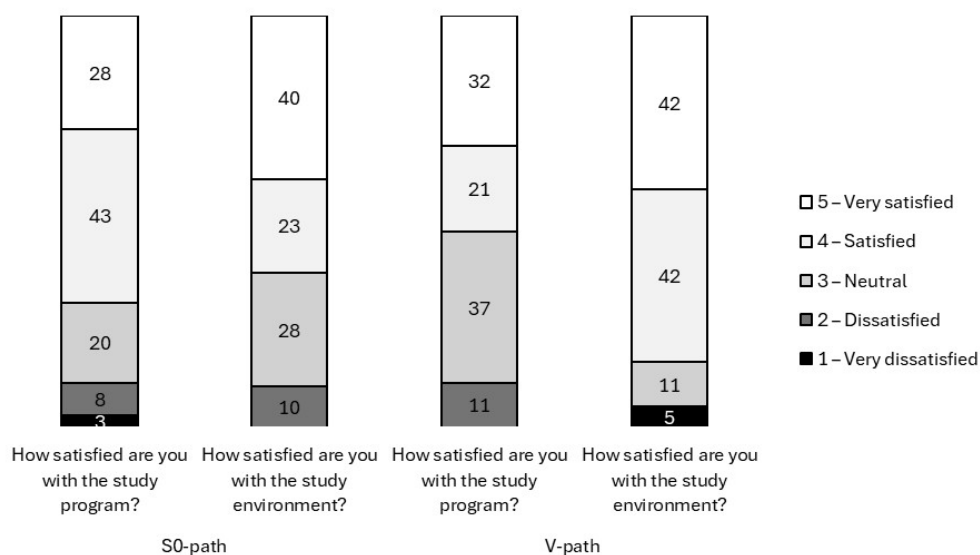


Figure 2. Response distribution (in %) to the questions “How satisfied are you with the study programme?” and “How satisfied are you with the study environment?”

Figure 3 shows the preferences for different elements of the study programme, categorised into prefer less, prefer more and satisfied. Differences emerge with respect to group work. Among V-path students, 37% wish for more group work, and none wish for less. In contrast, 23% of SO students want less group work, while only 15% want more. This may indicate that V-path students place greater value on collaboration as a learning strategy, particularly as support when dealing with theoretical subjects. These findings can be interpreted as reflecting different learning strategies and needs. For V-path students, group work may function both as academic support in theoretical subjects and as a familiar working method from professional practice. Their generally higher motivation and clearer goal orientation may

also help them manage group dynamics more effectively, rather than responding to difficulties by working alone or changing group members, which several students reported doing in a previous research conducted at UiA [8]. At the same time, differences in motivation and goal orientation between student groups may contribute to group work being perceived as less beneficial by SO students. Students admitted through SO report limited knowledge about the types of jobs civil engineers hold and how the construction industry functions. Some indicate that they chose the programme rather randomly and are not necessarily strongly interested in the field. This aligns with findings [8], showing that most students experience challenges in group work, including free riding, varying ambition and skill levels, and disagreements among group members, challenges that become more pronounced as students' progress through their studies. This is not reported as a challenge among V-path students, who are generally more dedicated, goal-oriented, and motivated to complete their degree. Such differences may lead to student groups with very different levels of motivation, which could partly explain why V-path students express a stronger preference for group work than SO students. Strong peer collaboration may also help explain why V-path students report higher satisfaction with the learning environment than SO students.

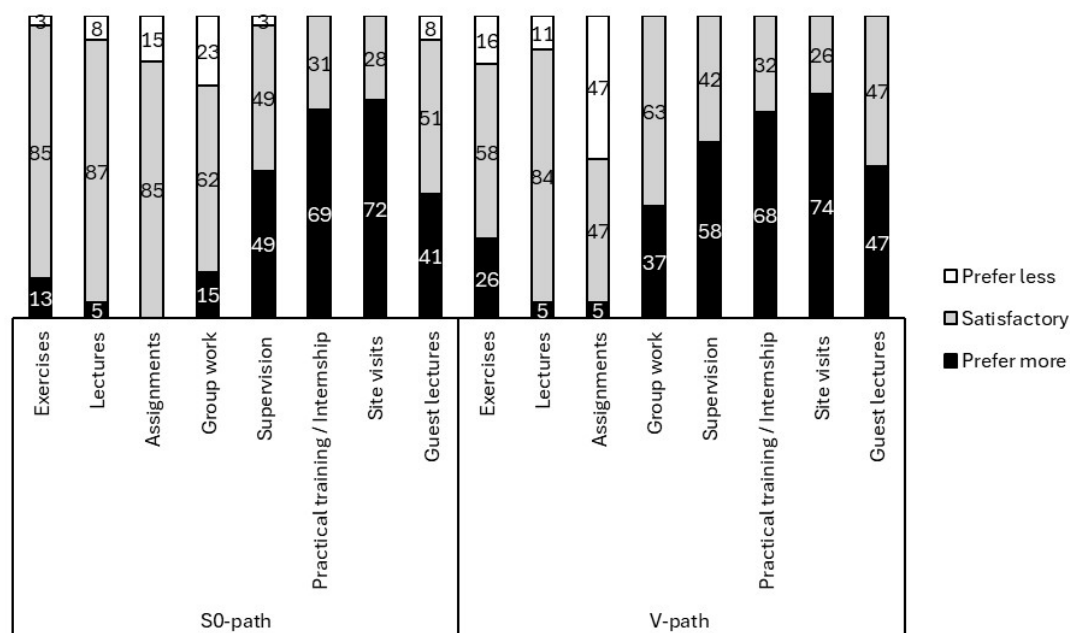


Figure 3. Preferences for different elements of the study programme

The results provide indications of which measures V-path students believe could contribute to improved learning outcomes and higher completion rates. A majority (58%) request more academic guidance, and 26% want additional exercise sessions. At the same time, 47% wish to have fewer mandatory assignments, which may be related to limited time resources and a high overall workload. Several V-path students also call for more student assistants or mentoring arrangements that can provide concrete support with assignments and exercises. Such initiatives may also help ease the transition from a practically oriented work background to a more academically focused learning environment.

Furthermore, our findings suggest that it is a need for increased flexibility in the study structure, particularly for students with family obligations. This includes the timing of lectures and the general availability of campus-based activities. Digital teaching materials are suggested as a potential means of increasing flexibility; however, some students express concern that extensive use of digital solutions could negatively affect the already strong learning environment. Students admitted through SO express somewhat different priorities. Many wish for less group work and more guidance, although to a lesser extent than V-path students. In addition, SO students want a clearer introduction to what engineers actually do in professional practice, as well as more practically oriented teaching related to how buildings are constructed. Since SO students report fewer difficulties with theoretical subjects, while V-path students have stronger insight into engineering practice, increased collaboration between the two groups could potentially benefit both. However, there is also a risk that students may be unwilling to

work together due to differences in motivation, expectations, and working styles, which could reduce the effectiveness of such collaboration if not carefully facilitated.

4 CONCLUSIONS

This study demonstrates that students with vocational and academic backgrounds bring different but complementary strengths to civil engineering education. V-path students benefit from extensive practical experience, which enhances learning, motivation, and engagement in construction-related subjects, and they place strong value on group work as a familiar and supportive working method. At the same time, they face significant challenges in theoretically demanding subjects such as mathematics, physics, and academic writing, consistent with research linking the Realistic personality type to difficulties in abstract, theory-based assessment systems. When combined with family responsibilities and limited flexibility, these challenges may increase the risk of dropout. Differences in students' structural conditions also influence overall satisfaction. While students admitted through SO report higher satisfaction with academic content and greater schedule flexibility, V-path students, despite experiencing more academic challenges, report particularly high satisfaction with the learning environment. This suggests that strong social integration and collaborative learning play an important role in supporting vocational students. Overall, the findings underline the need for flexible study structures, varied working methods, and targeted academic support that recognises diverse student backgrounds and leverage group work to strengthen both learning outcomes and persistence in engineering education.

Further studies need to be carried out in order to validate the results, given the small sample size and relatively short observation period. Additional methods could also be employed. For instance, this could include an examination of completed credits, grades, and completion rates among V-path and SO students. This study is currently based solely on self-reported data, and supplementary methods could contribute to a clearer understanding of the topic.

REFERENCES

- [1] Knowledge T. N. M. O. Regjeringa vil gjere profesjonsutdanningane meir fleksible og praksisnære. [Online]. Available: <https://www.regjeringen.no/no/aktuelt/regjeringa-vil-gjere-profesjonsutdanningane-meir-fleksible-og-praksisnare/id3032614/?expand=factbox3032616>.
- [2] TEKNA. Regjeringa tar ikke kompetansekrise i teknologi og realfag på alvor." [Online]. Available: <https://www.tekna.no/aktuelt/regjeringa-tar-ikke-kompetansekrise-i-teknologi-og-realfag-pa-alvor/>.
- [3] Songer N. B. A crisis in STEM education: We must fund STEM education research focused on interdisciplinary problem solving. [Online]. Available: <https://www.openaccessgovernment.org/article/a-crisis-in-stem-education-we-must-fund-stem-education-research-focused-on-interdisciplinary-problem-solving/193941/>.
- [4] Yi Ding Q. W., Hourieh N. and YuQ. Vocational Personality Types in College Engineering Students in Relation to Academic Achievement. *Journal of Employment Counselling*, vol. 57, no. 1, pp. 27–47, 2020, doi: <https://doi.org/10.1002/joec.12136>.
- [5] Høgskolerådet U. O. Alternative opptaksveier og tilpassede ingeniørutdanninger. 2025.
- [6] Holland J. L. *Making vocational choices: A theory of vocational personalities and work environment*. 1985.
- [7] Mtshali T. Occupational Training for TVET College Civil Engineering Students in the Modern Era: Has Anything Changed? *Journal of Technical Education and Training*, vol. 13, pp. 82–91, 12/20 2021, doi: [10.30880/jtet.2021.13.04.007](https://doi.org/10.30880/jtet.2021.13.04.007).
- [8] Heimdal A. Group Work in Engineering Education: Insights and Issues presented at the International Conference on Engineering and Product Design Education, Malta, 2025.