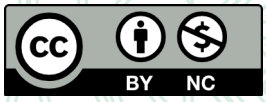
THE PERFORMANCE OF A DIVERSE COHORT OF CIVIL ENGINEERING STUDENTS AT UNITEC INSTITUTE OF TECHNOLOGY (2010 TO 2019)

WEI LOO
LUSA TULEASCA

Pedagogy / student success



This publication may be cited as: Loo, W., & Tuleasca, L. (2021). The Performance of a Diverse Cohort of Civil Engineering Students at Unitec Institute of Technology (2010 to 2019). In E. Papoutsaki and M. Shannon (Eds.), *Unitec Research Symposium Proceedings 2020* (pp. 54–72). Auckland, New Zealand: ePress, Unitec New Zealand.

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ISBN 978-0-473-59389-6

ePress

Unitec Institute of Technology
TE WHARE WĀNANGA O WAIRAKA

ABSTRACT

The growth in international students over the past decade, and large-scale immigration into the Auckland area, have both contributed to a rapidly diversifying student cohort at Unitec New Zealand. In the period 2010 to 2019, 1856 distinct students studied civil engineering at Unitec. Within the domestic cohort alone, these students came from 39 different nationalities, and at least 28 different ethnic groups. The topic of this paper is how educational performance is associated with various demographic characteristics, particularly in respect of nationality, ethnicity, gender, age, part-time or full-time study, and activity prior to study. Particularly important are the findings pertaining to the New Zealand Government's designated priority groups. Māori in civil engineering are underrepresented in relation to their proportion of the population in West Auckland, but are performing well academically, whereas domestic Pasifika, who are well represented, are falling behind other groups in terms of educational performance. International students, on the whole, academically outperform domestic students. The article concludes with 17 key findings, and a recommendation that future research focuses on students who drop out of civil engineering during their first year of study. An enhanced understanding of this group of students has the potential to significantly improve educational performance indicators for civil engineering, starting from when students begin their first semester of study in the discipline.

KEYWORDS

civil engineering, diverse student cohort, educational performance, Unitec New Zealand

INTRODUCTION

Civil Engineering is described in the *Encyclopaedia Britannica* as "the profession of designing and executing structural works that serve the general public" (Garth Watson, 1999).

Civil engineering education has over 40 years of history at Unitec New Zealand (formerly named Carrington Technical Institute until 1994, then Unitec Institute of Technology until 2020). In 1976, Carrington Technical Institute was established at the present Mt Albert site. Within two years, delivery of the partly work-based New Zealand Certificate in Engineering (NZCE) in both the civil and mechanical disciplines had already started. While the NZCE was reputed to serve students and industry very well, in 1998 the government began to progressively disestablish the qualification. The replacement qualification, developed by a consortium of polytechnics, was the Level 6 Diploma in Engineering (Civil) in 2000. This was quickly followed by the launch of the Bachelor of Engineering Technology (Civil) at Unitec in 2001. Both these qualifications were initially offered in the civil discipline only (Kirman & Blakely, 2018).

In 2010, both the diploma and the degree were brought under the auspices of nationwide governing bodies – the New Zealand Board of Engineering Diplomas (NZBED) and the Metro Group of Institutes of Technology, respectively. This was done to bring greater consistency to graduate outcomes, curricula, and course content right across the country. It is important to note that the New Zealand Diploma in Engineering (NZDE) and the Bachelor of Engineering Technology (BEngTech) are also governed by international accords – the Dublin Accord in the case of the NZDE, and the Washington Accord in the case of the BEngTech. These accords anchor the programmes to

international best practice and help ensure their international recognition – at least throughout most of the English-speaking world.

This article is primarily concerned with the demographic characteristics and educational performance of civil engineering students who enrolled in the civil engineering diploma or degree programme at Unitec during the period 2010 to 2019. This is a particularly interesting period, which during its first half enjoyed a near doubling of enrolments. It was also a period of rapid demographic change. For example, in 2010, international students represented just 11% of the civil engineering cohort. By 2016 this had increased to 45%. Altogether, by the end of the decade under study, 1856 students representing a diverse cohort of 39 different nationalities and 29 ethnicities had enrolled at some point, in one or more courses of study in civil engineering. These facts alone make the matter of diversity and academic achievement in civil engineering at Unitec a topic well worth studying.

Notes:

- EFTS (Equivalent Full-time Students): A typical full-time student studies 8 x 15-credit courses in a year, representing 1 EFTS. One 15-credit course therefore corresponds to 0.125 EFTS.
- The National Diploma in Engineering (Civil) started phasing out in 2011 and was replaced by the New Zealand Diploma in Engineering (Civil) in 2011. In this article, the term NZDE(Civil) likewise refers to both qualifications.
- The data supporting the study is sourced from Unitec's PeopleSoft enrolment database. The data is processed using the UnionBI application (Loo, 2016–2021). UnionBI provides a user-friendly interface allowing for the automated scripting and batch processing of large and complex SQL statements, and the efficient presentation of reports and charts.

CIVIL ENGINEERING: BROAD ENROLMENT TRENDS

The earliest records of civil engineering enrolments in Unitec's PeopleSoft database are from 2001. Thus, to date, more than two decades of enrolment data are available. Enrolment trends in civil engineering from 2001 to 2019 are presented in Figure 1.

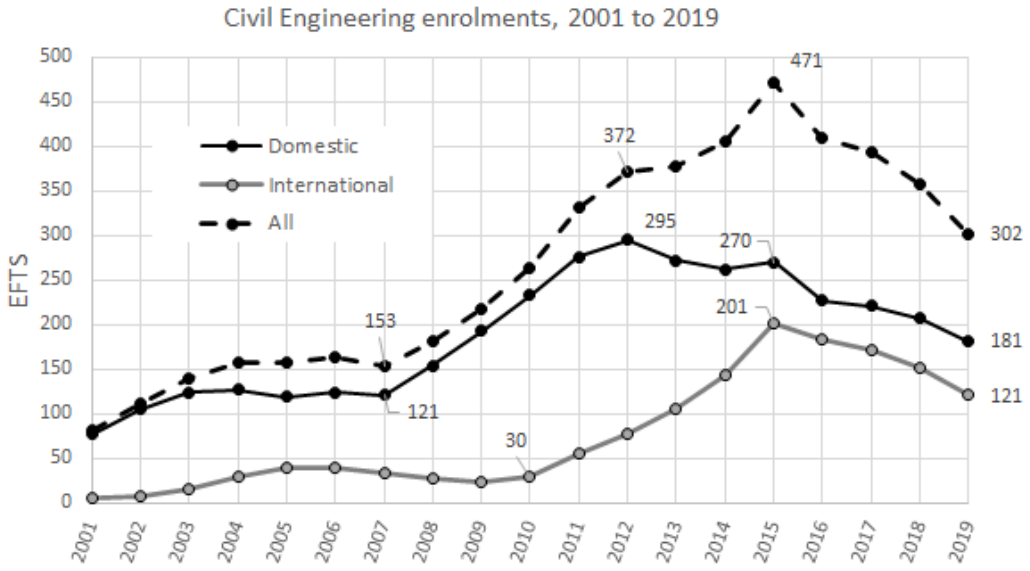

Figure 1. Civil engineering enrolments, 2001 to 2019 (EFTS).

Between 2007 and 2012, growth was largely driven by domestic enrolments increasing by nearly two and a half times – from 121 EFTS in 2007 to 295 EFTS in 2012. After 2012, domestic enrolments gradually declined. Various reasons have been proposed for the decline, and these are mentioned later in this section. Nevertheless, despite the post-2012 decline in domestic students, overall growth was sustained for another few years due to a huge increase in internationals during the period 2010 to 2015. In this five-year period, international enrolments increased almost seven-fold – from 30 EFTS in 2010 to a peak of 201 EFTS in 2015.

However, after 2015, international enrolments also entered a decline. This, together with the continued reduction of domestic enrolments, contributed to a 36% decline in civil engineering EFTS over the 2015 to 2019 period. This reduction in civil engineering enrolments was consistent with the 37% fall in *overall* enrolments (9706 EFTS to 6088 EFTS) across the institute over the same period (see Figure 2).

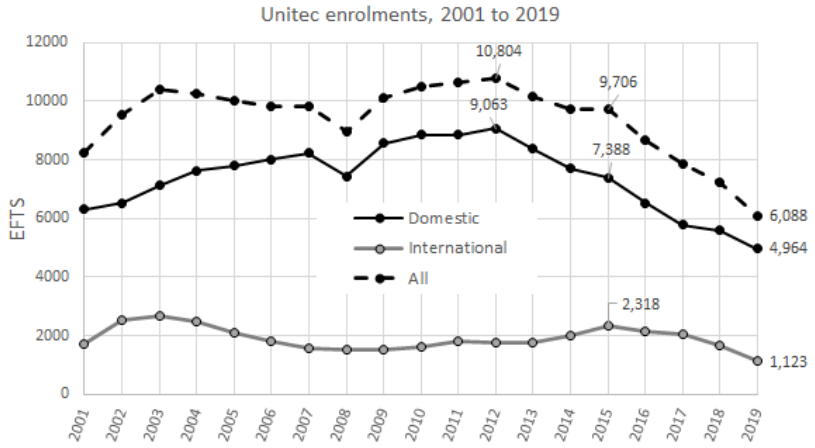

Figure 2. Unitec Institute of Technology, enrolments across all programmes, 2001 to 2019.

Unitec's struggles in attracting students in recent years have been variously attributed to a buoyant labour market in the period leading up to the 2020 Covid-19 situation (Gerritsen, 2019), the reputational damage caused by the failed 'transformation' restructure of 2013 to 2017 (Loo, 2018), and the dangers of emphasising corporate managerialism over staff voice (Kenkel, 2020; Loo, 2019). Successive NZQA category downgrades, from Category 1 to 2 in late 2016, and Category 2 to 3 in late 2018, damaged the public reputation of Unitec, and created difficulties in processing international visas. The failure of Unitec's 'transformation' has been exposed by Dr David Cooke in his report *Blind Faith: Deconstructing Unitec 2015 to 2017* (Cooke, 2018), and has also been extensively reported on in the media (Collins, 2018; Franks, 2018).

In Figure 3, civil engineering enrolments are decomposed into the BEngTech(Civil) and NZDE(Civil).

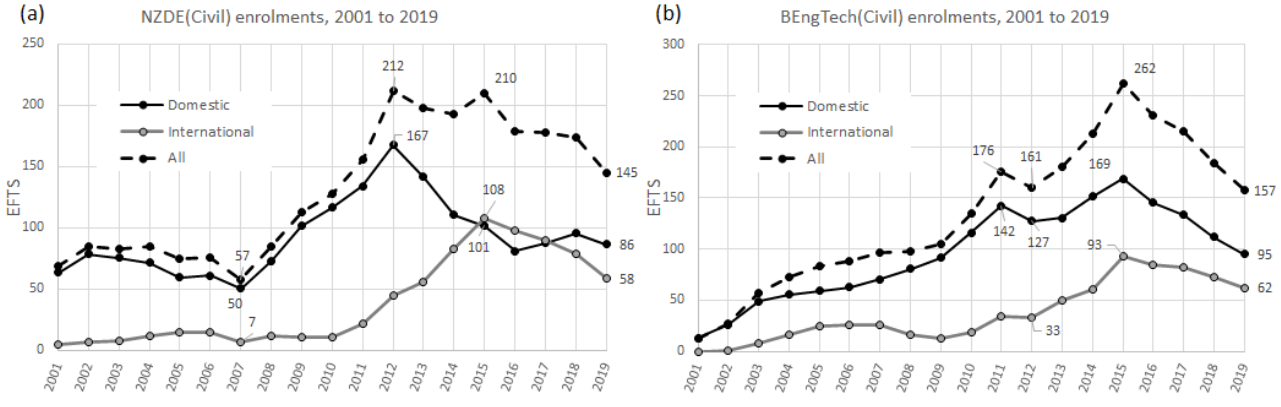

Figure 3. Civil engineering enrolments, 2001 to 2019 (a) for the NZDE(Civil) and (b) for the BEngTech(Civil).

It is seen that both the BEngTech(Civil) and the NZDE(Civil) are characterised by significant growth in enrolments in the ten-year period leading up to 2015, particularly of international students. By 2015, the NZDE(Civil) had more than half its student cohort of international origin, while over one third of BEngTech(Civil) students were international. However, since 2015, the proportion of international students within the civil engineering cohort has declined, with a possible contributing factor being the NZQA category downgrade mentioned above.

The following sections narrow the focus to students who studied civil engineering during the 10-year period of 2010 to 2019. A decade is a naturally and commonly accepted duration of time adopted for academic study, with further salience obtained by the fact that 2010 was the year when the revised BEngTech(Civil) degree was introduced across the country, followed by the roll-out of the new NZDE(Civil) qualification in 2011.

DEMOGRAPHIC CHARACTERISTICS AND EDUCATIONAL PERFORMANCE (2010 TO 2019)

In the 10-year period 2010 to 2019, Unitec's Department of Civil Engineering educated 1856 students (by head count), studying either on the BEngTech(Civil) or the NZDE(Civil). These students represent 3684 EFTS of enrolments. On average, each student thus enrolled in 2 EFTS (16 x 15-credit courses), the equivalent of two years of full-time study. In terms of individual *course* enrolments, there were 15,154 in the BEngTech(Civil) and 14,665 in the NZDE(Civil).

Figure 4 presents these enrolments both in terms of head count and EFTS.

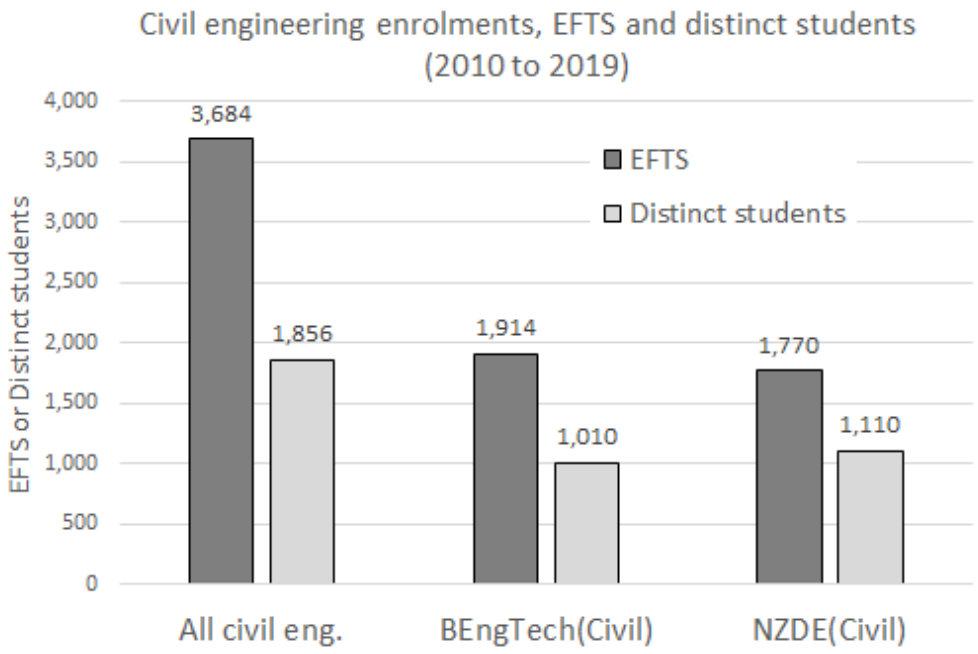

Figure 4. BEngTech(Civil) degree and NZDE(Civil) enrolments (EFTS and Distinct students), 2010 to 2019.

Overall educational performance is presented in Figure 5. Note that course success is simply the aggregate number of courses passed, divided by the total number of courses enrolled less courses listed as continuing or deferred. GPA stands for Grade Point Average. Unitec adopts the 0 to 9 grade-point system common to most New Zealand tertiary institutes (The University of Auckland, 2021).

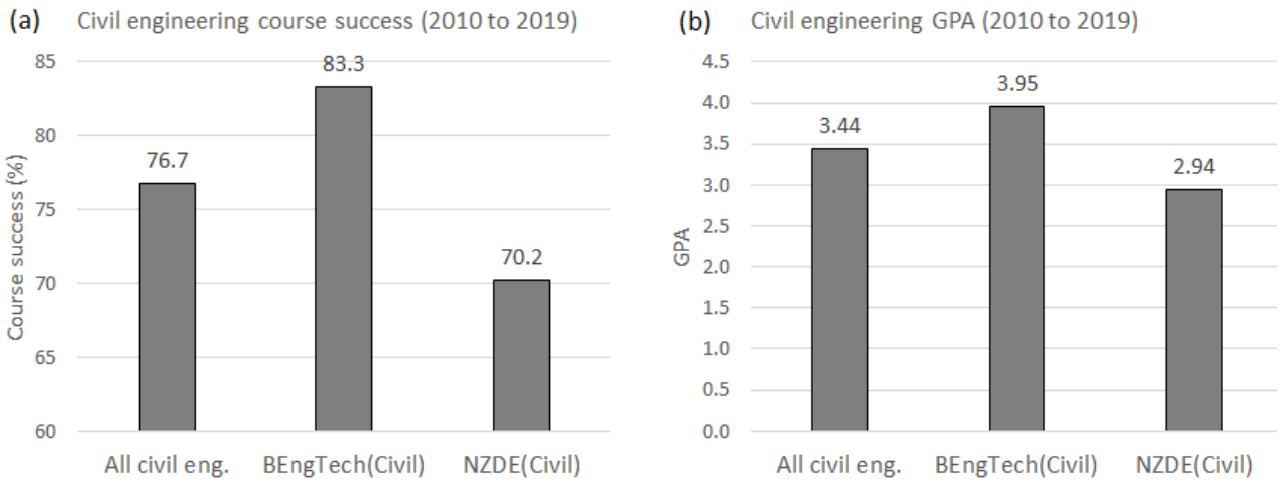

Figure 5. Civil engineering educational performance in terms of (a) course success and (b) GPA.

In the following sections we investigate the student cohort with respect to six key demographic statistics: nationality, ethnicity, gender, prior activity, age and part-time or full-time study.

Nationality

Over the ten-year period 2010 to 2019, students from 39 nationalities enrolled in civil engineering. Table 1 shows the EFTS enrolments by nationality. The nationalities are further categorised as domestic (New Zealand citizens, permanent residents and Australian citizens), or from one of seven broad geographic regions – Asia, Middle East, the Pacific, Africa, North America, South America or Europe.

As a proportion of overall EFTS enrolments, 67% of civil engineering students are domestic, 24% from Asia, 5% from the Pacific, and 2% from the Middle East (see Figure 6). Just 2% are from 'other' regions, namely North and South America, Africa and Europe. It is emphasised that this refers to *nationality*, and not ethnicity. While *ethnicity* often closely correlates with *nationality*, they are different concepts. Note that Figure 6 also provides the nationality breakdown for the BEngTech(Civil) and NZDE(Civil), separately.

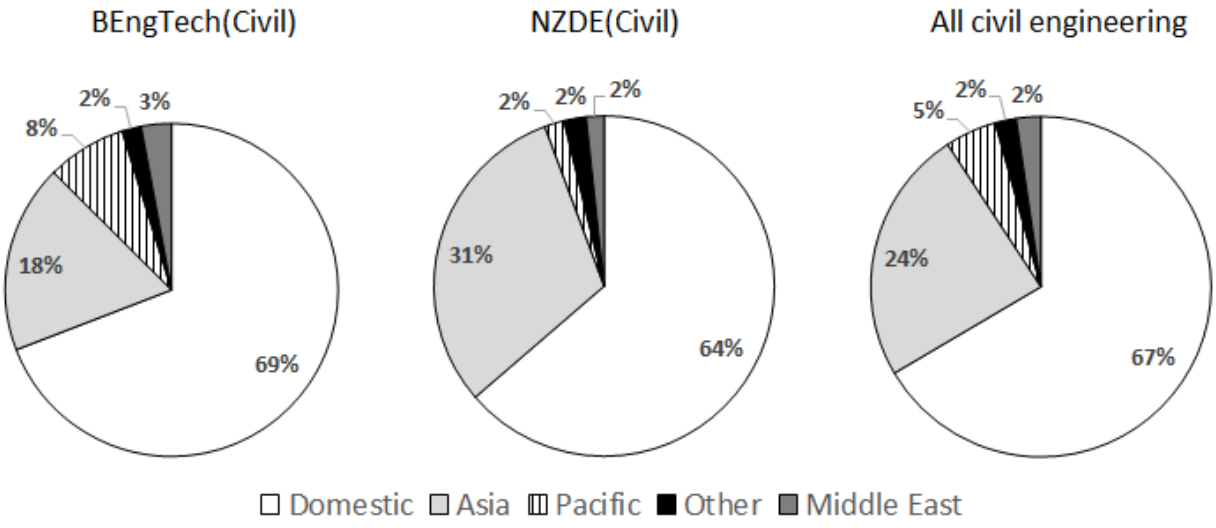

Figure 6. Students by broad geographical region, in percentages.

Residency	Region/Category	Degree	Diploma	Total	Percent
NZL: New Zealand	Domestic	804	754	1559	42.4%
NZP: New Zealand Permanent	Domestic	510	365	875	23.8%
CHN: China	Asia	241	334	575	15.7%
IND: India	Asia	68	135	203	5.53%
SAU: Saudi Arabia	Middle East	51	24	75	2.05%
SLB: Solomon Islands	Pacific	49	3	52	1.42%
LKA: Sri Lanka	Asia	12	26	38	1.02%
KEN: Kenya	Africa	14	22	36	0.98%
FJI: Fiji	Pacific	17	19	36	0.97%
TON: Tonga	Pacific	27	1	28	0.75%
PNG: Papua New Guinea	Pacific	17	6	23	0.64%
KIR: Kiribati	Pacific	15	3	18	0.49%
RUS: Russian Federation	Europe	5	9	15	0.40%
VUT: Vanuatu	Pacific	14	0	14	0.37%
TWN: Taiwan	Asia	9	3	12	0.32%
VNM: Viet Nam	Asia	3	7	10	0.27%
AUS: Australia	Domestic	8	2	10	0.26%
KOR: Korea Republic of	Asia	1	7	8	0.23%
BGD: Bangladesh	Asia	3	4	8	0.21%
WSM: Samoa	Pacific	7	1	8	0.20%
PHL: Philippines	Asia	4	4	7	0.20%
NPL: Nepal	Asia	0	7	7	0.18%
TMP: East Timor	Asia	5	2	7	0.18%
IRN: Iran (Islamic Republic Of)	Middle East	2	4	6	0.17%
CHL: Chile	South America	3	2	5	0.13%
BRA: Brazil	South America	4	0	4	0.12%
PAK: Pakistan	Asia	1	3	4	0.11%
FRA: France	Europe	4	0	4	0.11%
HKG: Hong Kong	Asia	0	3	3	0.09%
MMR: Myanmar	Asia	3	0	3	0.09%
ZAF: South Africa	Africa	1	2	3	0.08%
THA: Thailand	Asia	0	3	3	0.08%
TUV: Tuvalu	Pacific	3	0	3	0.08%
MUS: Mauritius	Africa	3	0	3	0.07%
KHM: Cambodia	Asia	0	3	3	0.07%
IRQ: Iraq	Middle East	2	1	2	0.07%
USA: United States	North America	2	0	2	0.05%
NAM: Namibia	Africa	0	2	2	0.05%
JOR: Jordan	Middle East	2	0	2	0.04%
OMN: Oman	Middle East	0	1	1	0.01%
	Totals	1912	1761	3673	100%

Table 1. National origin of civil engineering students (EFTS), 2010 to 2019.

In terms of educational performance, international students outperform domestics, both in terms of course success and GPA, across both the NZDE(Civil) and BEngTech(Civil) programmes (see Figure 7).

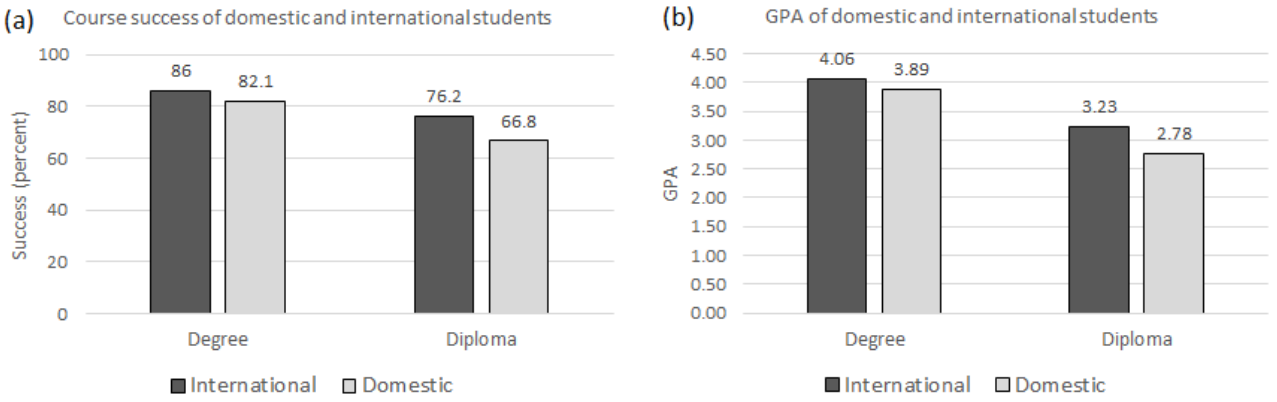

Figure 7. Educational performance of international vs domestic students, in terms of (a) course success and (b) GPA.

Educational performance in terms of geographic region is presented in Figure 8. Note that only four broad groupings are shown – Domestic, Asia, Pacific and Middle East. These four groupings make up 98% of enrolments in terms of EFTS.

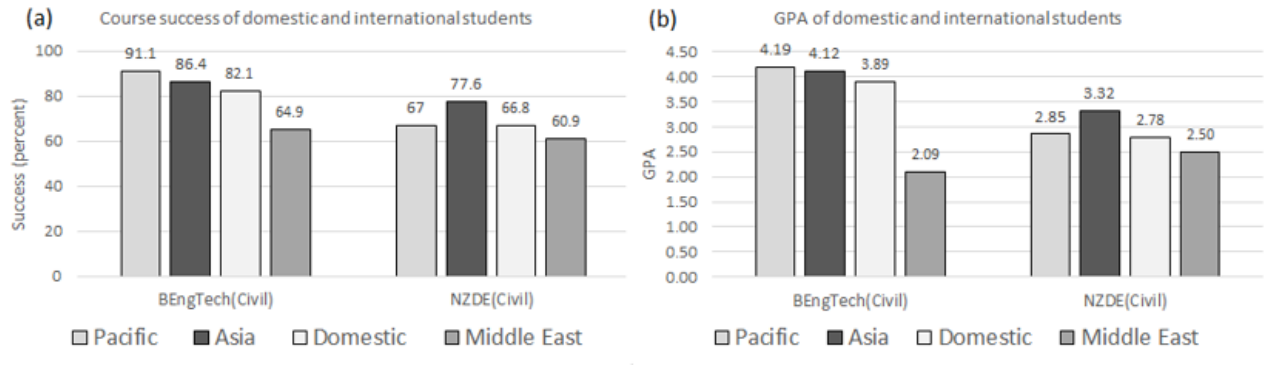

Figure 8. Educational performance by geographic region, (a) course success and (b) GPA.

From Figure 8 it is seen that for the BEngTech(Civil) degree, students from the Pacific perform the best, followed by students from Asia, and then domestic students. Students from the Middle East lag significantly behind students of other groups. For the NZDE(Civil), students from Asia perform the best, followed by students from the Pacific, then domestic students, while again, students from the Middle East are found to be struggling compared with students from other groups.

Ethnicity (of domestic students)

Domestic students make up 67% of EFTS of the civil engineering cohort (2010 to 2019) – see Figure 6. These domestic students are from at least 28 ethnic groups (two of the groups are 'other' or 'no response'). The ethnicities are grouped as African, Asian, European, Latin American, Māori, Middle Eastern and Pasifika. These classifications are adopted in the New Zealand census (StatsNZ, 2018). In the case of students who belong to two or more ethnicities, the ethnicity adopted by Unitec for reporting is assumed to be in line with the ethnic priority rankings used by New Zealand's Ministry of Education (Education Counts, 2021).

Enrolments by ethnicity and ethnic group are shown in Table 2.

		Enrolments (EFTS)			
Ethnicity	Group	Degree	Diploma	Total	Percent
NZ European/Pakeha	European	249.5	250.6	500.1	20.5%
Indian	Asian	274.1	165.1	439.3	18.0%
Chinese	Asian	153.5	84.9	238.4	9.76%
Other	Other	93.0	68.9	161.9	6.63%
Middle Eastern	Middle Eastern	76.2	72.9	149.1	6.10%
New Zealand Maori	Maori	48.5	93.5	142.0	5.82%
African	African	54.6	56.8	111.4	4.56%
Samoan	Pasifika	47.3	50.4	97.7	4.00%
Tongan	Pasifika	40.0	45.1	85.1	3.48%
Other Asian	Asian	56.8	23.2	80.0	3.27%
Filipino	Asian	41.1	38.6	79.7	3.26%
Other European	European	25.1	28.0	53.1	2.17%
Fijian	Pasifika	25.1	25.9	51.0	2.09%
Cook Island Maori	Pasifika	11.5	26.2	37.7	1.54%
Latin American	Latin American	20.5	8.4	28.8	1.18%
Other Pasifika Island	Pasifika	11.5	14.4	25.9	1.06%
No response	No response	16.4	9.1	25.5	1.04%
Korean	Asian	12.3	8.3	20.6	0.84%
Sri Lankan	Asian	13.8	6.0	19.7	0.81%
Niuean	Pasifika	3.4	12.9	16.3	0.67%
British/Irish	European	6.7	9.5	16.1	0.66%
Other South East Asian	Asian	9.6	6.2	15.8	0.65%
Australian	European	7.5	2.7	10.2	0.42%
Vietnamese	Asian	3.2	6.1	9.3	0.38%
Dutch	European	5.8	2.0	7.8	0.32%
Japanese	Asian	7.1	0.0	7.1	0.29%
German	European	4.9	2.2	7.1	0.29%
Cambodian	Asian	3.4	0.0	3.4	0.14%
Polish	European	0.0	2.1	2.1	0.09%
		1322	1120	2442	100%

Table 2. Ethnicity of domestic civil engineering students (2010 to 2019)

Figure 9 shows the proportional break-down of the major ethnic groups.

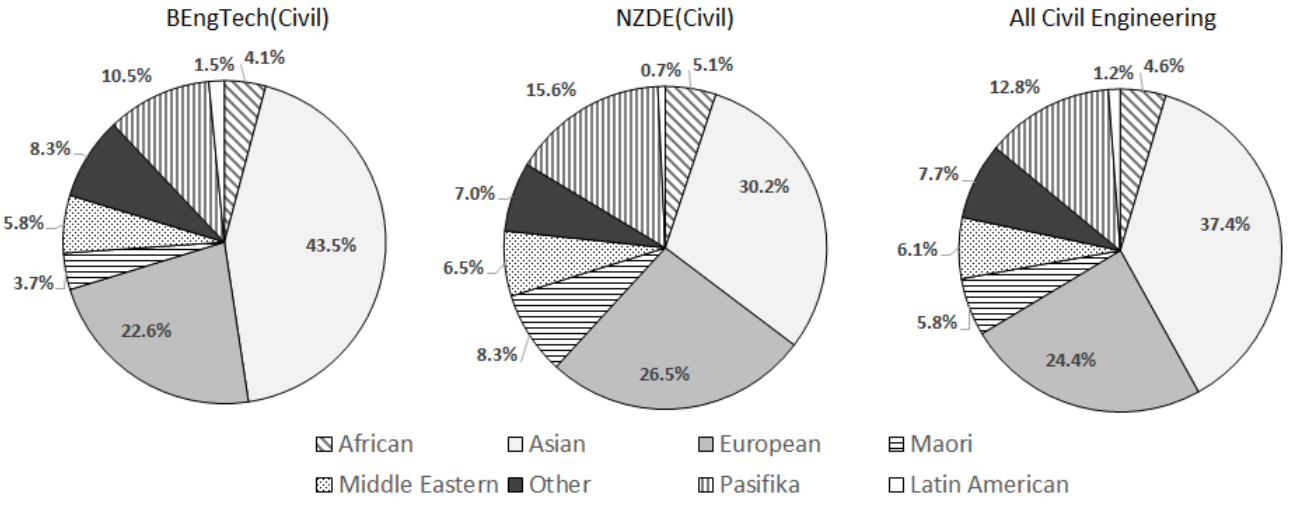

Figure 9. Ethnic background of domestic students as a proportion of all civil engineering students.

From Figure 9, out of all civil engineering students, the largest group are of an Asian ethnicity (37.4%), followed by European (24.4%), Pasifika (12.8%), Māori (5.8%), Middle Eastern (6.1%), African (4.6%) and Latin American (1.2%).

Pasifika and Māori are both priority groups in terms of encouraging participation and enhancing educational performance (Unitec, 2019–2020). The other priority group is under-25s – see the section titled 'Age of students.' The main 'catchment' for domestic students is the West Auckland area. Around 12% of the population in this area identify as Māori and 14% as Pasifika (Huakau, 2016). The proportion of Pasifika in civil engineering (12.8%) appears to be quite close to their representation in the community (14%). However, Māori, at just 5.8% of the overall cohort, are significantly underrepresented – given that 12% of the local population is Māori.

Educational performance by ethnicity (of domestic students only) is presented in Figure 10. Overall domestic success is also included (black column).

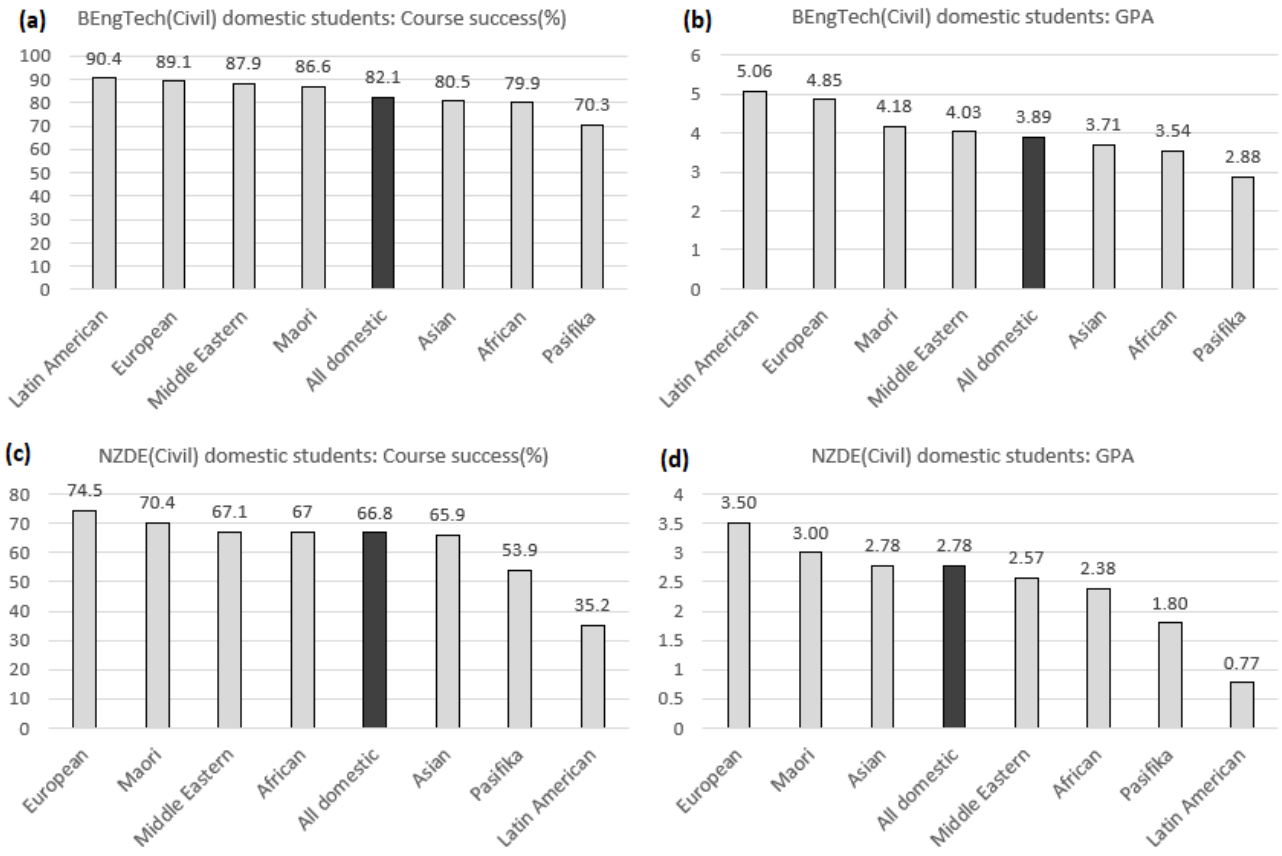

Figure 10. Educational performance by ethnic background (for domestic students only) for the BEngTech(Civil) in terms of (a) course success, (b) GPA, and for the NZDE(Civil) in terms of (c) course success, and (d) GPA.

If we disregard the very small number of Latin American enrolments, domestic students of European ethnicity perform the best in both programmes, whether in terms of course success or GPA. Māori also perform well in both programmes, exceeding the overall domestic performance in terms of both success and GPA. However, Pasifika course success and GPA in both programmes lag significantly behind the overall averages. For the BEngTech(Civil) the overall success rate is 82.1%, which is 11.8 percentage points above the 70.3% of Pasifika. For the NZDE the overall success rate is 66.8%, while Pasifika success is just 53.9% (12.9 percentage point gap).

An interesting finding is that among domestic Pasifika students, Pasifika *New Zealand permanent residents* significantly outperform Pasifika *New Zealand citizens*. This applies in the case of both the NZDE(Civil) and BEngTech(Civil) (Figure 11).

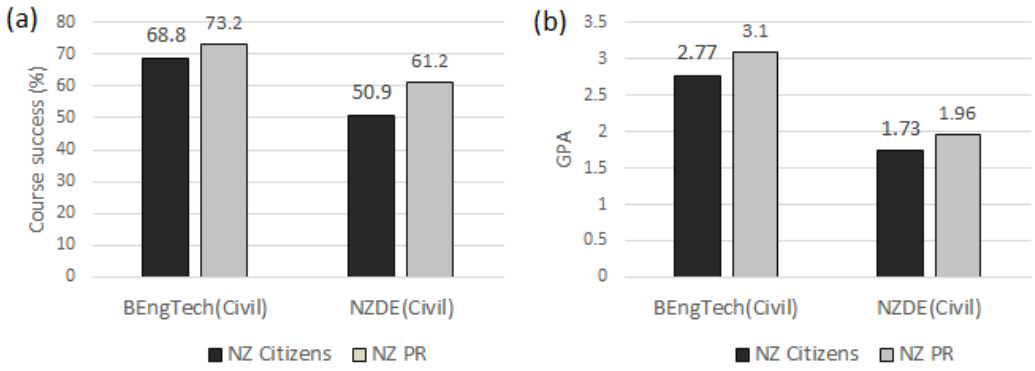

Figure 11. Pasifika students: New Zealand citizens vs New Zealand permanent residents (PR) in terms of (a) course success for the BEngTech(Civil) and NZDE(Civil), and (b) GPA for the BEngTech(Civil) and NZDE(Civil).

Gender

From Figure 12, civil engineering clearly has difficulty in attracting female students. In the BEngTech(Civil) only 12.7% of students are female, while for the NZDE(Civil) just 11.9% of students are female. For domestic students the rate of female participation is 16.5% and 14.1% for the BEngTech(Civil) and NZDE(Civil) respectively, while for internationals the corresponding rates are 12.7% and 12.3%.

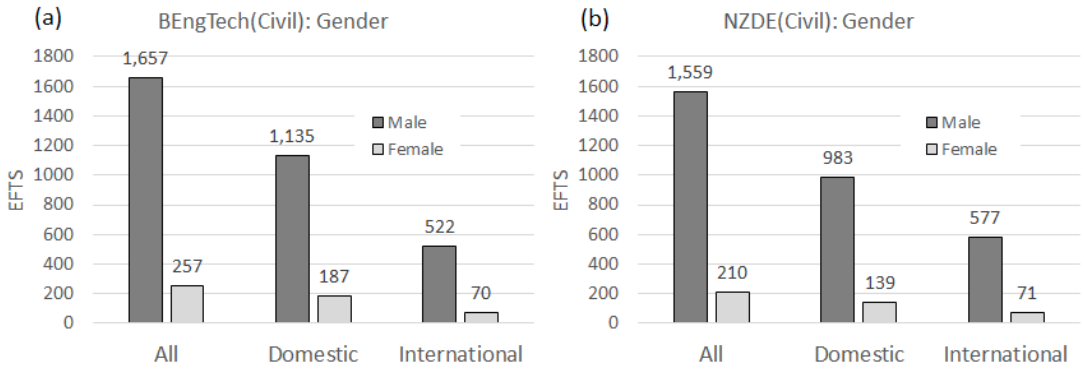

Figure 12. Female and male students for the (a) BEngTech(Civil), and (b) NZDE(Civil).

Despite female students being significantly under-represented, they perform well academically (see Figure 13). In terms of course success, female internationals outperform male internationals, who in turn outperform female domestics, who outperform male domestics (Figure 13 [a]).

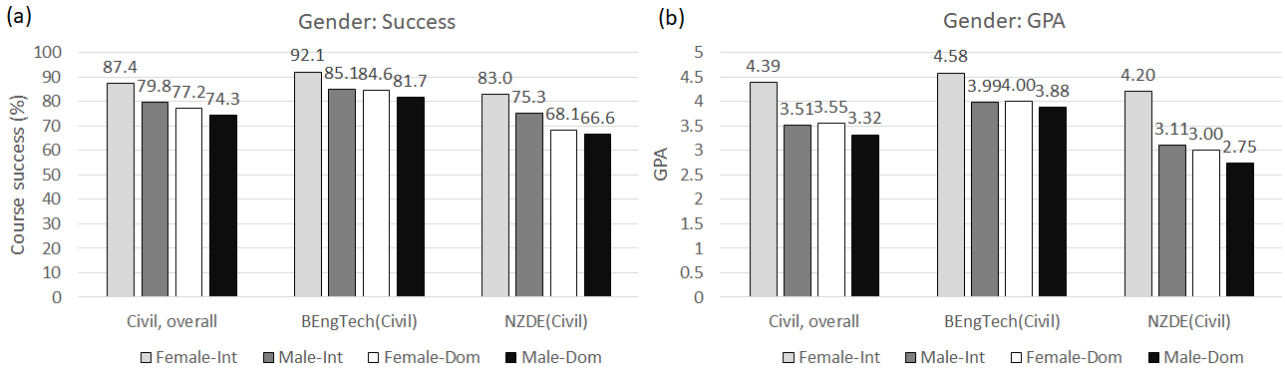

Figure 13. Educational performance by gender, in terms of (a) course success rates and (b) GPA.

Prior activity

The term *prior activity* refers to the activity the student was involved in immediately before his or her *first* semester of study at Unitec, regardless of programme. The prior activities of students enrolled on the BEngTech(Civil) and NZDE(Civil) during 2010 to 2019, are shown in Figure 14.

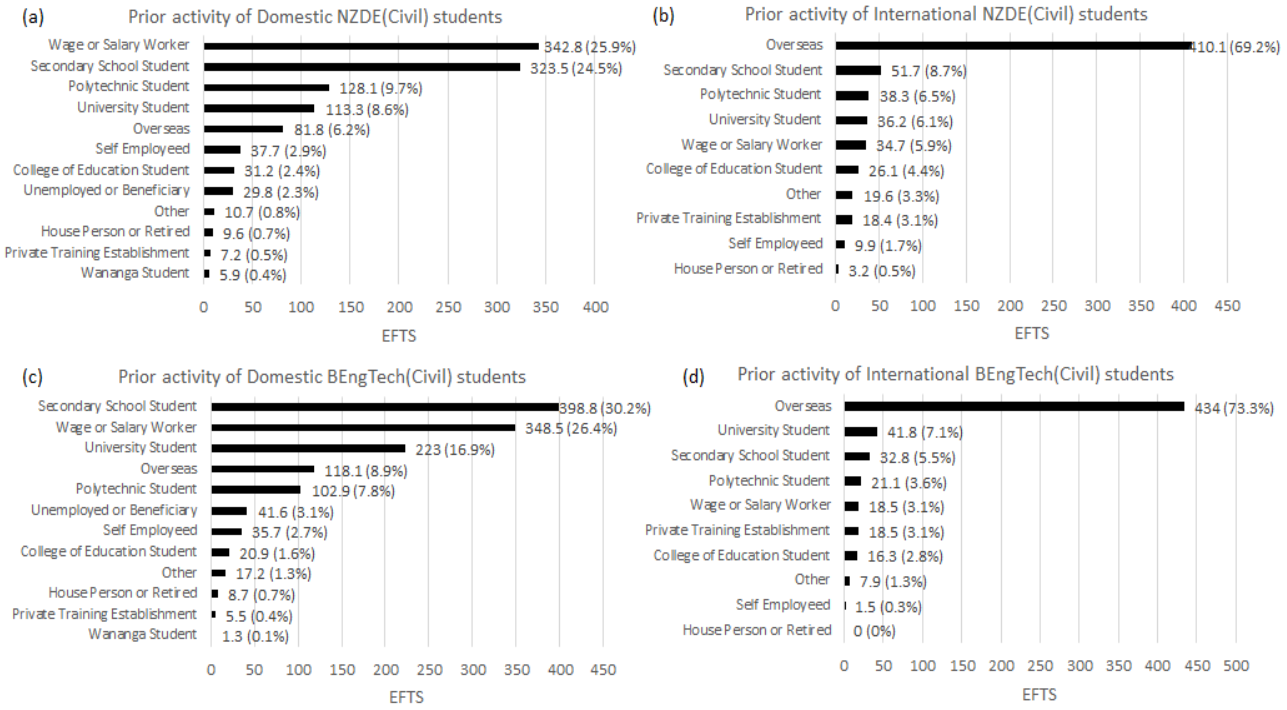

Figure 14. Prior activities of (a) domestic NZDE(Civil) students, (b) international NZDE(Civil) students, (c) domestic BEngTech(Civil) students and (d) international BEngTech(Civil) students.

A plurality of domestic NZDE(Civil) students (25.9%) come from a wage or salary background. Former secondary school students also make up a significant percentage of the domestic NZDE cohort (24.5%). For the BEngTech(Civil), 30.2% are from a secondary school background, followed by wage or salary background (26.4%). Most international students arrived at Unitec straight from overseas (69.2% for the NZDE and 73.3% for the BEngTech).

To simplify the investigation of prior activity and educational performance, the following broad groupings of activities are adopted and presented in Table 3.

Tertiary education	Secondary school	Workforce	Unemployed	Overseas
College of Education Student	Secondary School Student	House Person or Retired	Unemployed or Beneficiary	Overseas
Polytechnic Student		Self Employeed		
Private Training Establishment		Wage or Salary Worker		
University Student				
Wananga Student				

Table 3. Grouping of prior activities.

Course success and GPA associated with prior-activity group, for degree and diploma, and international and domestic students, are shown in Figure 15.

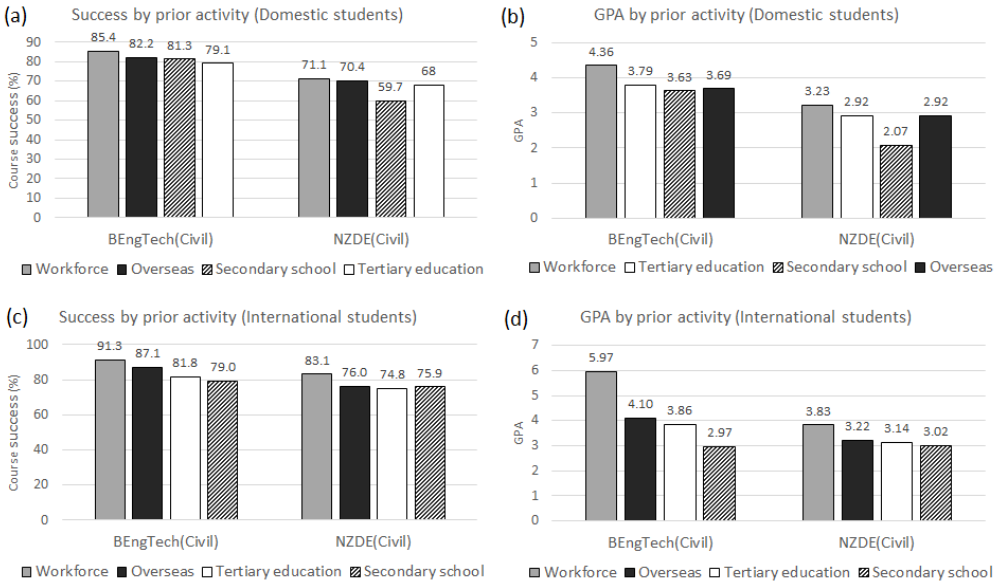

Figure 15. Course success by prior activity of (a) domestic BEngTech(Civil) and domestic NZDE(Civil) students, (b) GPA by prior activity of domestic BEngTech(Civil) and domestic NZDE(Civil) students, (c) course success by prior activity of international BEngTech(Civil) and international NZDE(Civil) students, (d) GPA by prior activity of international BEngTech(Civil) and international NZDE(Civil) students.

From Figure 15, students who arrive from the workforce, regardless of whether they are domestic or international, have the highest rates of course success on both programmes. Students from the workforce also significantly outperform other students when it comes to GPA. Students arriving directly from overseas, whether domestic or international, also have high rates of success on both programmes.

Age of students

The ages of civil engineering students (based on enrolments between 2010 to 2019) are shown in Figure 16. Note that the *age* given is the age at the beginning of the semester for the relevant course studied. The distributions are weighted by EFTS. As would be expected, the mean age and median age of BEngTech students is higher than that of NZDE students. The spread (standard deviation) of the age distributions is similar for both groups.

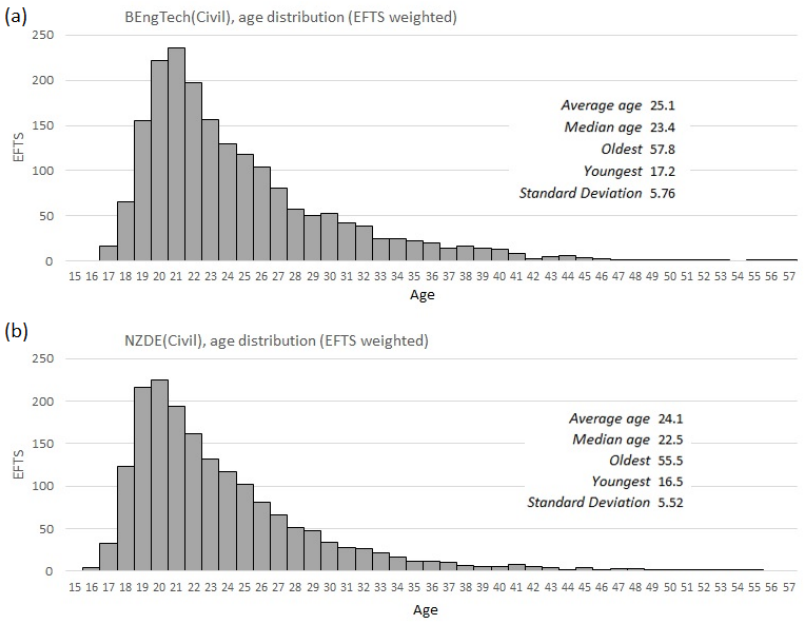

Figure 16. EFTS-weighted age distribution (at start of course) for (a) BEngTech(Civil) students, and (b) NZDE(Civil) students.

Success and GPA are plotted against age (excluding those age ranges with fewer than 30 enrolments) and presented in Figure 17. Age and educational performance are seen to be highly correlated.

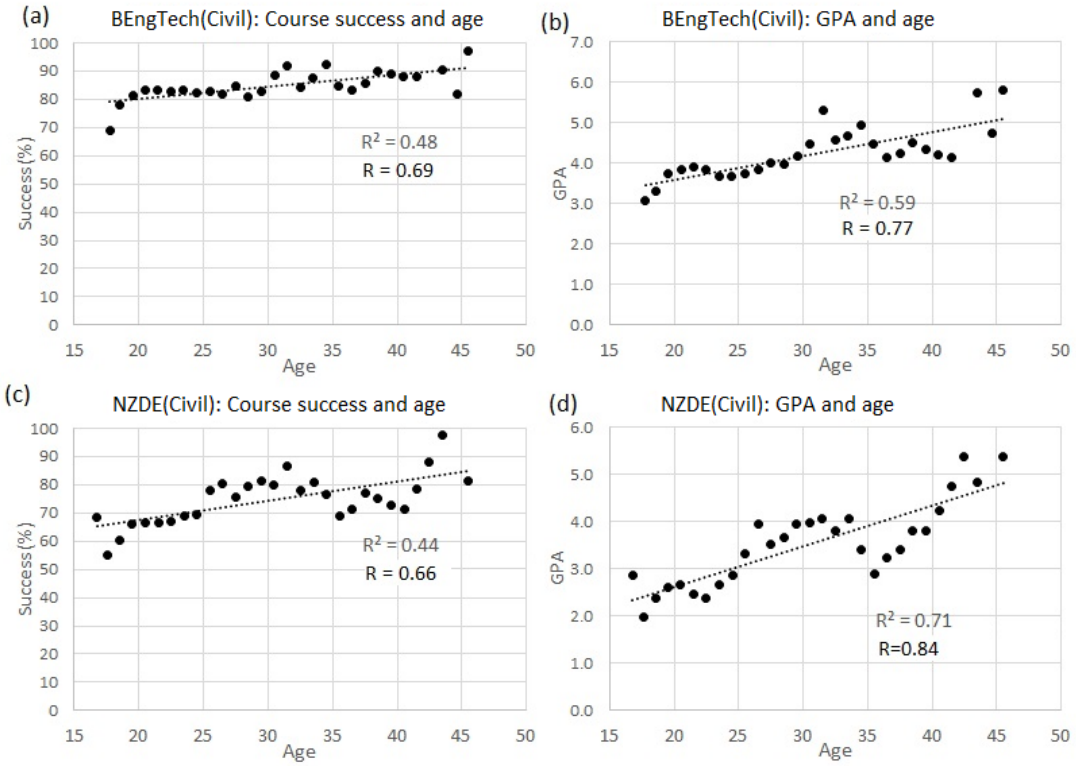

Figure 17. Educational performance and age for the BEngTech(Civil) in terms of (a) course success, and (b) GPA, and NZDE(Civil) (c) success, and (d) GPA.

Domestic under-25 students are a priority group when it comes to improving educational performance (Unitec, 2019–2020). There are significantly more students in this age range than older than this group. Enrolment figures in terms of EFTS are shown in Figure 18.

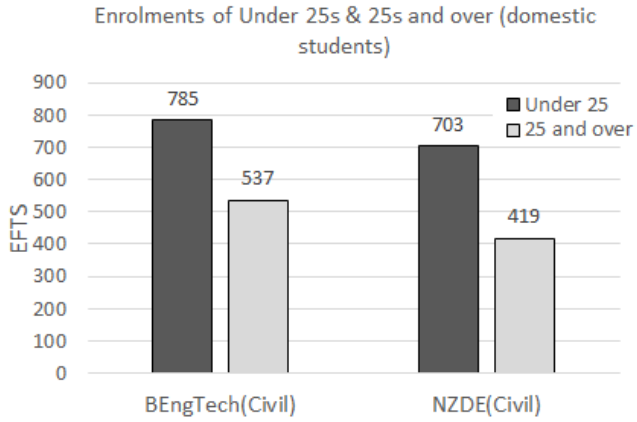

Figure 18. Domestic enrolments by age, for under-25s, and 25s and over.

Figure 19 compares educational performance for under-25s, and 25s and over.

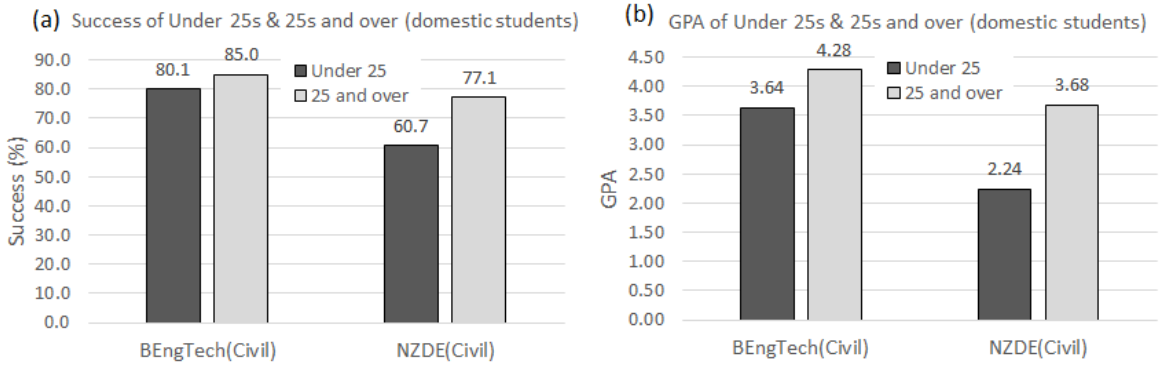

Figure 19. Educational performance for under-25s, and 25s and over.

As expected from the strong correlation of age with educational performance, under-25s underperform compared with their older counterparts.

Part-time or full-time study

Part-time students are those students who enrol in three or fewer 15-credit courses a semester. Full-time students are enrolled in four or more 15-credit courses a semester. The enrolments from 2010 to 2019 associated with part-time and full-time study are presented in Figure 20. Note that as international students are rarely involved in part-time study (just 125 of 1240 EFTS), only the figures relating to domestic students are displayed. Around 23% of domestic enrolments are of students studying part time.

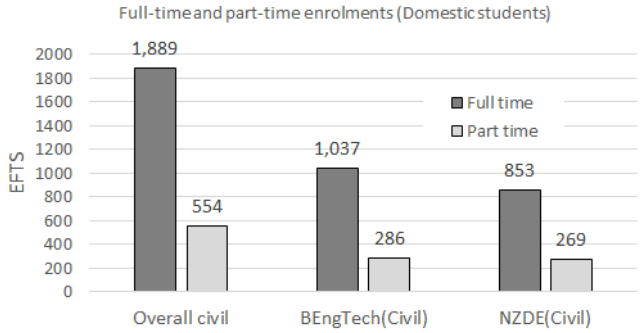

Figure 20. Domestic students in full-time and part-time study.

Figure 21 compares the educational performance of full-time with part-time students. Clearly, full-time students tend to perform better than part-time students, particularly those enrolled in the NZDE(Civil).

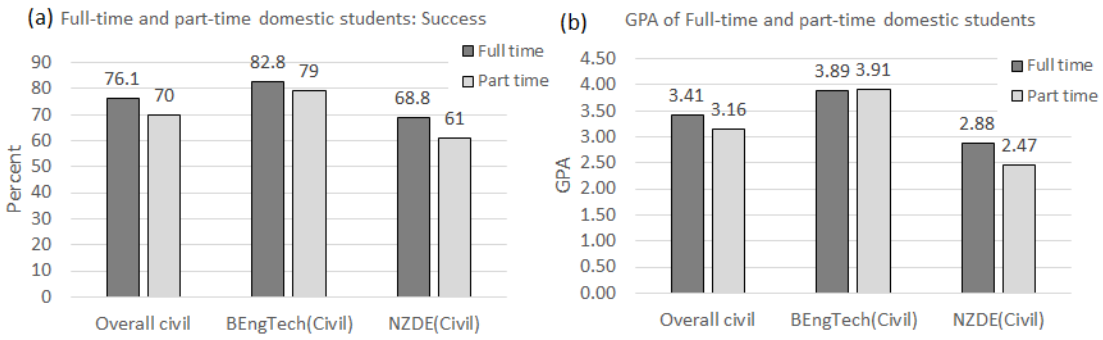

Figure 21. Domestic students in full-time and part-time study; (a) course success, and (b) GPA.

Educational performance and retention (2010 to 2019)

The relationship between educational performance and semester of study on the NZDE is shown in Figure 22. Figure 22 (a) shows the educational performance of students on the NZDE with increasing semester of study. Figure 22 (b) shows the same, but only for those students *who ended up studying for the minimum required four semesters* of the NZDE.

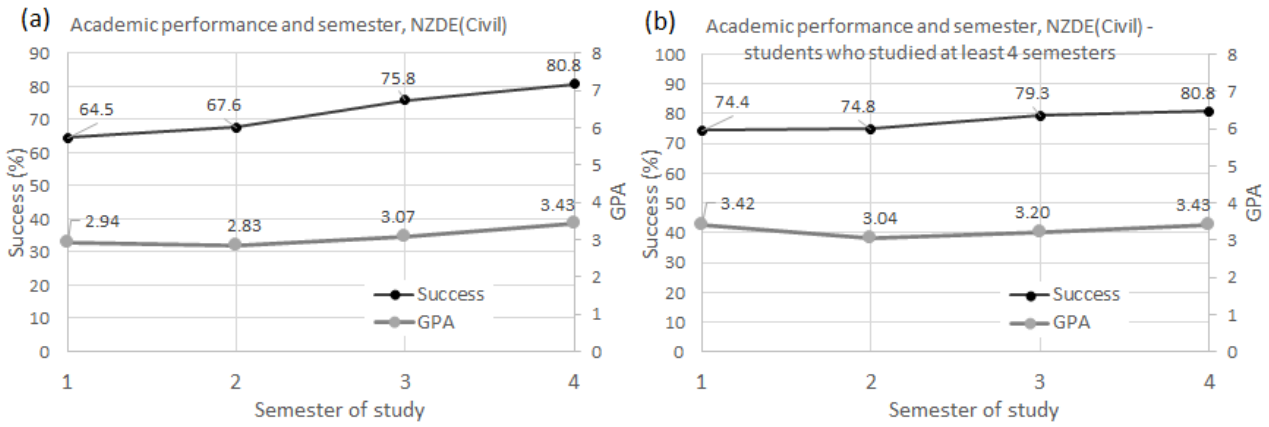

Figure 22. Educational performance and semester of study for (a) students who commenced studies at Unitec in the NZDE(Civil), and (b) only those students who commenced studies at Unitec in the NZDE(Civil) and studied for four semesters.

Educational performance, in the aggregate, increases significantly with increasing semesters of study (Figure 22 [a]). However, if only the results of students who ended up completing four semesters are included, educational performance appears to be consistently high over time (Figure 22 [b]). It would appear, then, that over time the performance of most students does not improve, but rather overall results are kept down in the initial semesters by poorly performing students. When these students drop out, the average performance subsequently lifts.

This is also seen for the BEngTech(Civil) (see Figure 23). Students in the first semester of study have an overall course success of 76.9%. This consistently improves with increasing semesters, to 92.4% in Semester 6 (see Figure 23 [a]).

However, if only the results of students who study the minimum six semesters required for completion are considered, educational performance over time does not improve significantly, but instead remains high over time (Figure 23 [b]).

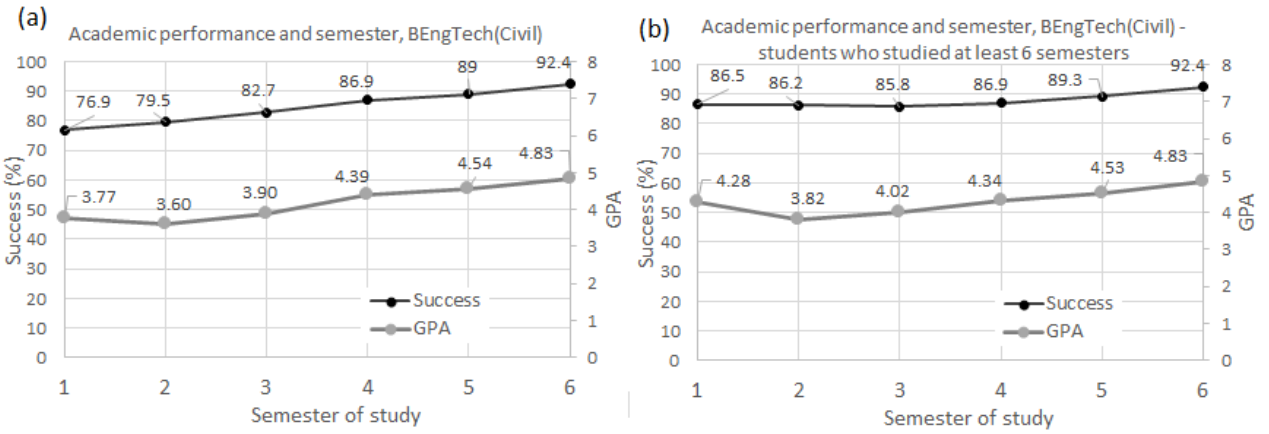

Figure 23. Educational performance and semester of study for (a) students who commenced studies at Unitec in the BEngTech(Civil), and (b) only those students who commenced studies at Unitec in the BEngTech(Civil) and studied for six semesters.

The retention rates of students who started a civil engineering programme during the period under study are shown in Figure 24.

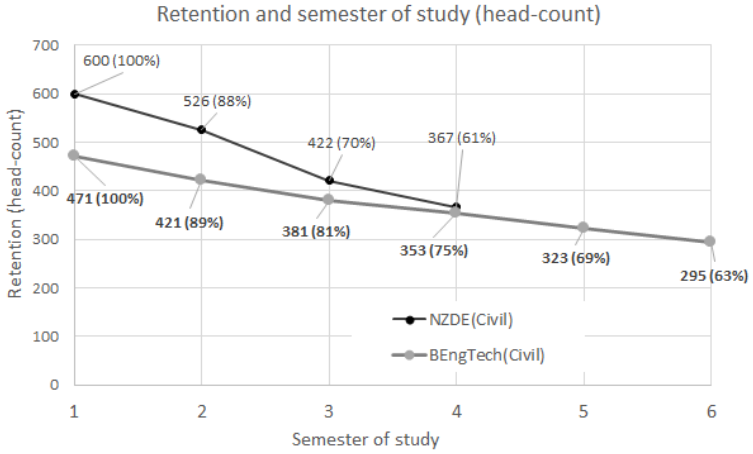

Figure 24. Retention of civil engineering students (2010 to 2019).

After two semesters of study, the NZDE loses 30% of its original cohort, and the BEngTech(Civil) loses 19%. The performance of the students who drop out after one or two semesters (within the first year) of study are shown in Table 4.

	BEngTech(Civil)		NZDE(Civil)	
	Success (%)	GPA	Success (%)	GPA
Retained after 2 sems	84.1	3.96	72.4	3.17
Dropped out after 2 sems	39.2	1.73	45.8	1.98

Table 4. Educational performance of first-year retained students compared with non-retained.

As expected, the performance of the retained students is very much higher than that of the non-retained students. If the results of the non-retained students are removed from the dataset, first-year success would be as high as 84% for the BEngTech(Civil) and 72% for the NZDE(Civil).

An understanding of why students drop out of civil engineering, particularly in the first year of study, would be particularly useful in coming up with measures to improve overall success.

CONCLUSION AND RECOMMENDATIONS

Key findings on demographic characteristics and how they relate to educational performance (2010 to 2019) are presented below:

1. International students typically outperform domestic students academically.
2. International Pasifika perform the best among international students, while students from the Middle East struggle compared with students from other nationalities.
3. Of domestic students, students of Asian ethnicity are a plurality (37.4%).

4. Pasifika students' representation among domestics (12.8% of EFTS) is quite close to their representation in the West Auckland community (14%).
5. Māori comprise just 5.8% of the domestic cohort and appear to be underrepresented, given that 12% of West Auckland identifies as Māori.
6. The highest-performing group among domestic students is European.
7. Māori, despite their underrepresentation in the domestic cohort, consistently perform close to Europeans in terms of course success.
8. However, domestic Pasifika success lags significantly behind that of other ethnic groups. Within this group, Pasifika permanent residents outperform Pasifika New Zealand citizens.
9. Female students are significantly underrepresented in civil engineering, at around just 12% of overall EFTS (future research could focus on how Unitec fares in this regard compared with other New Zealand technical institutes and universities, and whether the number of female teaching staff is a factor when it comes to increasing female enrolments).
10. However, female students outperform their male counterparts academically, particularly international female students, who have a course success rate of 87.4%.
11. Most international students (around 70%) come directly from overseas prior to studying civil engineering at Unitec.
12. A significant proportion of domestic students arrives straight from the workplace – around 30% of enrolments for both programmes.
13. One quarter of domestic BEngTech(Civil) students comes directly from a New Zealand secondary school. The figure for the NZDE(Civil) is 24.5%.
14. Students arriving directly from the workforce perform well academically compared with other students. This applies in the case of both domestic and international students, and across both programmes.
15. Educational performance correlates strongly with age of students. Older students tend to perform better than younger students. For example, on the NZDE(Civil), 25 and older students have a course success rate of 77.1%. For under-25s it is 60.7%.
16. Full-time students on both programmes tend to perform better than part-time students. The gap in performance for the NZDE(Civil) is significant – 68.8% course success for full-timers compared to 61% for part-time students.
17. Students who end up completing either the BEngTech(Civil) or NZDE(Civil) qualification tend to perform consistently well academically, from the start to the end of their studies.

Future research on those students who drop out after one or two semesters of study is a possible 'low-hanging fruit' when it comes to improving overall educational performance of the two civil engineering programmes. Funding to comprehensively explore the background of these students before they start their studies, the reasons they leave their studies and their destinations after leaving their studies, could allow improvements to be made to selection criteria, and support of at-risk students during the early period of study.

REFERENCES

Collins, S. (2018, August 1). Unitec reviews controversial changes after financial crisis. *NZ Herald*. https://www.nzherald.co.nz/nz/unitec-reviews-controversial-changes-after-financial-crisis/SJX2QON6GZJ4U4AYI2DPTEIAXA/

Cooke, D. (2018). *Blind faith: Deconstructing Unitec, 2015 to 2017*. Quality Public Education Coalition.

Education Counts. (2021). *Ethnic group codes*. https://www.educationcounts.govt.nz/data-services/code-sets-and-classifications/ethnic_group_codes

Franks, J. (2018, August 23). $50 million cash injection for Unitec. *Stuff*. https://www.stuff.co.nz/national/education/106497597/50-million-cash-injection-for-unitec

Garth Watson, J. (1999). Civil engineering. *Encyclopedia Britannica*.

Gerritsen, J. (2019, December 19). *Polytechs suffer another year of student decline*. RNZ. https://www.rnz.co.nz/news/national/405816/polytechs-suffer-another-year-of-student-decline

Huakau, J. (2016). *Locality population snapshot: West Auckland* (2nd ed.). Te Whānau o Waipareira Research Unit, Te Pou Matakana.

Kenkel, D. (2020). *The neoliberal experiment at Unitec. Burning down the house! What happened – what we learnt – and ideas on guarding our future tertiary sector*. Paper presented at the Quality Public Education Coalition (QPEC) forum, May 9, 2020, online (Zoom) forum.

Kirman, F., & Blakeley, J. (2018). *From early beginnings: The origin and development of civil engineering education at Unitec Institute of Technology*. Unitec Institute of Technology, Te Whare Wānanga o Wairaka.

Loo, W. Y. (2016–2021). *UnionBI* [software].

Loo, W. Y. (2018). *Rebuilding public education: Lessons from Unitec's 'transformation' experience*. Presentation at the Quality Public Education Coalition (QPEC) forum, April 14, 2018, Auckland, New Zealand.

Loo, W. Y. (2019). *Marketisation and managerialism in vocational education: A Unitec TEU member's views on RoVE*. Presentation at the Quality Public Education Coalition (QPEC) forum, April 13, 2019, Auckland, New Zealand.

StatsNZ. (2018). *2018 Census ethnic group summaries*. https://www.stats.govt.nz/tools/2018-census-ethnic-group-summaries

Unitec. (2019–2020). *Investment plan (2019–2020)*. Unitec Institute of Technology, Te Whare Wānanga o Wairaka.

University of Auckland. (2021). *Calculating your grade point average*. https://uoa.custhelp.com/app/answers/detail/a_id/2454/~/calculating-your-grade-point-average

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