# Subject choice for the future of work

## Insights from research literature

Rosemary Hipkins and Karen Vaughan

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# Contents

# 1. Introduction

This research was commissioned by the New Zealand Productivity Commission to inform their study of the future of work in New Zealand. The main research question asks, in essence:

**In what ways are secondary school subject-choice systems, and students' subject choices, positioned to respond to future of work trends?**

This is a deceptively simple question which could be addressed from multiple starting points. As we searched for pertinent literature, we interrogated the following more specific sub-questions:

- Do institutional biases in schools, including the construction and delivery of careers advice, funnel students from different backgrounds toward certain education and career pathways?
- Is keeping options open until the end of secondary school a good strategy to prepare for an uncertain and rapidly changing future?
- Does the system architecture in New Zealand schools unnecessarily limit future choices for students?
- Does staying in school longer open more career/further study options? Does it close any options?
- How much variability is there in the system between schools, and what drives variability?
- In what ways do policy and regulatory settings limit flexibility in the schooling system and student choices?

## A study in two parts

This report scopes the context of subject-choice systems in New Zealand via a search for relevant local and international literature. It should be noted that contexts vary widely between different educational jurisdictions, and hence insights from the international literature need to be critically evaluated for relevance in local contexts (see Section 2).

The plethora of organisational arrangements in New Zealand secondary schools, combined with the modular flexibility afforded by the National Certificates of Educational Achievement (NCEA) system of assessment for qualifications, means that generalisations about what happens in schools are not readily forthcoming in the extant literature. Most of the pertinent research in New Zealand is small-scale and case-based. The second component of this research began with two focus groups with curriculum leaders from a range of different secondary schools. The report of that phase draws on the literature review and is published separately.[1]

1 Eyre & Hipkins. (2019). *Subject choice for the future of work: Insights from the focus groups*. Wellington: New Zealand Productivity Commission & New Zealand Council for Educational Research.

# 2.
# The context for this study

In this section we briefly outline several important sets of ideas that informed our literature search and analysis. First, and most obviously, it is important to scope the ideas and unknowns encapsulated by the phrase "the future of work".

## The future of work

The future of work describes the emerging impact on the world of work (and business models) from a number of transformative changes in society and economy. In particular, the world of work is being impacted by new technological developments.

One compelling metaphor for the future of work is the "rise of the robots". Some predictions focus on the disappearance of jobs—for example, disruptive technologies taking over routine work and artificial intelligence (AI) replacing humans. Other predictions focus on the emergence of different types of jobs—for example, where humans complement automation or where new technologies create demand for new kinds of services.

Human-influenced geological change (the Anthropocene) is another particularly significant trend sitting behind developments that may impact the future of work. It drives an increasingly urgent demand for different technologies to deal with environmentally damaging waste, climate change, and natural resource depletion. It also provides impetus for calls to change economic systems that are based on unchecked growth, consumerism, and wealth inequality, and to instead develop economies that are redistributive of wealth and regenerative of resources (Raworth, 2017; Slaughter, 2012). While automated technologies may be used to support more sustainable societies and economies, some labour-intensive forms of work may actually increase, at least in the short term (Gulson, Murphie, Sellar, & Taylor, 2018).

Although there is much debate about how the future of work will play out, there is consensus that what people do to earn a living is changing. Labour relations—*how* people do their work—are also changing. Important trends include the emergence of labour casualisation, digital nomads, the gig economy, and flexible working arrangements (Dunlop, 2016). These things mean that how we understand our value as humans may change as we start to consider what "productivity" and social roles might look like in future.

## "Capabilities" for future work

The idea of capabilities (or its close relation "key competencies") is a response to the uncertainties described in future-focused literature on life and work in the 21st century. *The New Zealand Curriculum* (hereafter *NZC*) (Ministry of Education, 2007) describes five key competencies, which are defined as "capabilities for living and lifelong learning" (p. 12). By implication they are needed for work and study, as well as for life in general in the years beyond school.

Every student needs to grow and develop the five key competencies of *NZC* throughout their years of schooling, including in the senior secondary school. These key competencies are *managing self; relating to others; thinking; participating and contributing*; and *using language, symbols and texts.* This set of five is New Zealand's considered version of an earlier set produced by the OECD (Hipkins, 2018). Vaughan (2017) noted that employers are increasingly interested in soft skills and dispositions for value creation in work and life. They have also said that many graduates or job applicants appear to be lacking these types of skills.

The notion of soft skills is evident in the *NZC* set of key competencies, in particular the competencies of *managing self, relating to others,* and *participating and contributing*. The implication is that the deployment of these in the senior secondary school should be considered alongside actual subject choice.

More recently, the OECD has revised its model. The revisions take account of the uncertainty generated by rapidly changing social and economic conditions, and the need for students to proactively shape "futures we want" rather than potentially being overwhelmed by change to the detriment of their wellbeing (OECD, 2018). At the time of writing, the OECD's *2030 Learning Compass* is itself continuing to evolve. The version currently on the front page of the 2030 website[2] differs from the one published in their 2018 report. This fluidity creates considerable challenges for education systems, which inevitably change at a more conservative pace given their complex organisational structures and the need for consultation. Changes to the substantive content of a national curriculum will almost certainly be contested by groups with differing understandings and interests.

Notwithstanding these complexities, a competencies/capabilities focus constitutes an important initial step in responding to "21st century" changes to work and life conditions (Howard, 2018). There is an argument to be made that a focus on developing capabilities/key competencies is more important than the actual subjects taken, and hence than subject choice per se. Caution is needed, however, because this argument rests on an assumption that all subjects offer similar opportunities to develop desirable capabilities—and that they do not do so at the expense of the substantive content of each subject. There is evidence that this is not yet the case. Some subjects (e.g., history) potentially offer richer opportunities in the senior secondary school than others (Johnston, Hipkins, & Sheehan, 2017). Additionally, schools are at very different stages in their understanding of the impact *NZC* key competencies could potentially have on the learning experiences offered to students in their different subjects (McDowall & Hipkins, 2018).

Another argument is that some subjects are more important than others for keeping learning pathways open. As we outline in Section 3, there is considerable international evidence to support this argument. Again, however, this needs to be interpreted cautiously because different nations have differently structured education systems.

2 https://www.oecd.org/education/2030-project/teaching-and-learning/learning/

## Types of national education systems

Now we turn to the idea of an "education system". This idea encompasses all the pieces that make up the way education is organised and delivered within a specific nation. Not all national education systems are built the same way. What pertains in one place might have less relevance in another, even if the two seem similar to the lay observer. The following examples illustrate this dilemma.

### The "logic" of the system

UK-based researchers Iannelli and Smyth (2017) describe two different logics that underpin national education systems:

- Systems with an *education* logic (e.g., Scotland, Ireland) blur the boundaries between school-based vocational and academic education, and hence there are weak links between vocational education and employment.
- Systems with an *employment* logic (e.g., the Netherlands) make a sharp distinction between academic and vocational education at school. These systems show clear associations between the type of learning pathway a student chooses and their employment outcomes.

There are variations within each type of system, and these can have a bearing on how students' school choices impact their school-to-work transitions. Iannelli and Smyth describe a key difference between the national systems of Scotland and Ireland. The latter has a common core of compulsory examination subjects (English, Irish, mathematics) and students typically choose several more. In Scotland, there are no compulsory subjects for the higher leaving certificate examinations—students are free to put together any combination, within the constraints of their individual school system.

Iannelli and Smyth draw on this difference to explain why grades are not significantly associated with employment chances in Scotland, but they are in Ireland. Their hypothesis is that students' subject choices in Ireland are broadly similar and hence grades are used to distinguish between individuals. Conversely, choosing maths and business studies is significantly associated with employment chances in Scotland but not in Ireland. Within the Scottish national system, many subject combinations are possible and so they provide a means of differentiating between individuals. These ideas are summarised in Table 1, which also provides a first indication of differences between these two systems and New Zealand's education system.

TABLE 1 **The role of education system structure in differentiating between students**

| | **Most structured choice of subjects** | | **Most open choice of subjects** |
|---|---|---|---|
| | **Ireland** | **Scotland** | **New Zealand** |
| **Type of evidence used to differentiate between students** | Grades | "Hard" (maths) or employment-relevant (business) subjects | NCEA credit totals (early years of NCEA)<br>Merit and Excellence awards (more recently) |

Like Ireland, England provides students with tightly structured choices. Since 2010 the English General Certificate of Secondary Education (GCSE) qualification has been structured as an "English Baccalaureate" (E Bacc). This specifies subjects considered to be academic: English, maths, the sciences (including computer science), history or geography, and a language. Only these subjects can contribute to the E Bacc qualification and therefore they shape choices across secondary schools, both leading up to E Bacc and for subsequent A-level studies. One consequence is that subject specialisation happens earlier in England than in many other countries (Anders, Henderson, Moulton, & Sullivan, 2018).

In these terms, the New Zealand education system is underpinned by an *education* logic. Senior secondary school qualifications—NCEA—make no distinction between the types of subjects from which students can gain credits. The system is even more open to subject choice than the Scottish system because each subject is itself assessed by a flexible combination of NCEA achievement standards and/or unit standards. Just because two students have taken physics, for example, does not guarantee that they will have both achieved an identical combination of knowledge and skills. This flexibility and openness means that the very concept of subject choice needs to be carefully appraised for meaning, as we discuss in Section 3.

The right-hand column in Table 1 suggests strategies students themselves might use to differentiate their academic performance in a system where "all credits are equal". They might, for example, seek to gain more credits than they actually need, or to gain more Merit and/or Excellence endorsements for individual achievement standards and for their qualification as a whole.

## Demographic and cultural differences

There are other contextual differences between the nations in which the various subject-choice research projects are set: in particular, demographic and cultural differences. Much of the published research has been carried out in the UK or the USA. Just some of the differences between these contexts and the New Zealand context are:

- There is more overt discussion of "class" differences in the UK-based literature and there is a focus on selecting/being selected for a more elite school. School decile might constitute an equivalent proxy measure in New Zealand. However, most New Zealand secondary schools are public schools. In the UK, and even Australia, there are many more private schools.
- A related difference concerns the existence of elite, or preferred, universities and *which* universities students are accepted for (e.g., Russell Group universities in the UK, Ivy League universities in the USA). Elitism in the tertiary sector is not as evident in the New Zealand literature.
- When diversity is the variable under consideration, ethnic profiles will obviously be very different. In UK-based literature, the minority cultures in focus tend to be Afro-Caribbean or Bangladeshi. In the USA they are Hispanic or African American. All these groups have different ethnic profiles from each other, and from Māori and Pacific Island cultures that feature in New Zealand-based research on subject choices.

One thing that these minority cultures have in common is that they tend to be over-representative of students from lower socioeconomic backgrounds. Cultural differences and comparative or actual poverty are confounded here. As Section 4 will discuss, students' backgrounds have a material impact on the types of choices they can envisage and make.

# 3.

# Subject choice in the New Zealand context

We turn now to the question at the heart of this review—how students' *subject choices* might impact on their working futures. The complexities outlined in Section 2 are brought directly to bear on the New Zealand context. We have already noted that our national system would be classified as being organised around an education logic rather than an employment logic. The system, as designed, should be able to respond flexibly to the learning needs of every student, helping them to make progress and experience success in their learning and achievements regardless of their prospective future pathway. Whether this ideal is achieved is another question, of course. (We will come back to this challenge in Section 4.)

Both the national curriculum framework (*NZC*) and the school-exit assessment/qualification system (NCEA) are designed to respond flexibly to the differing needs of different student groups. In research terms both are "loose"[3] structures that place considerable demands on teachers' subject and pedagogical expertise, and on the way school structures are designed. In some cases, students might miss out on their basic educational entitlements. This problem is not unique to New Zealand (Zohar & Hipkins, 2018) but the flexibility of both *NZC* and NCEA creates particular local challenges.

As we scoped this report, we wrote several case studies to highlight the complexity of contextual influences in play in the New Zealand context. The first of these case studies draws on the seminal Learning Curves project (Hipkins, Vaughan, with Beals, Ferral, & Gardiner, 2005). This was a 3-year longitudinal study of the impact of NCEA's introduction[4] on the subject choices available to students in six medium-sized secondary schools. Just to complicate matters, NCEA was introduced *before NZC* was developed, and has since been realigned to better reflect aspects such as the *NZC* key competencies, at least in theory.[5] At the time of writing this report, NCEA/*NZC* relationships have again been revisited as part of a broader NCEA review.

NCEA made it possible to gain credits towards a qualification from many different types of learning. The Learning Curves project described how, from the very first year of NCEA, schools began to design different types of courses for students with different learning needs (Hipkins et al., 2005). Students now needed

3 The implied comparison is with "tight" structures, such as traditional examination prescriptions that spell out the content that must be covered.
4 This took place as a series of rolling stages between 2002 and 2004.
5 Teachers perceived the realignment to be more effective in some subjects than in others (Hipkins, 2013).

to make course choices in the core curriculum areas of English, mathematics, and science, not just in the optional subject areas. Broadly, three different types of course began to evolve, each with some features in common. The names chosen for them reflect these features: traditional-discipline courses, locally redesigned courses, and contextually focused courses.

### A case study of evolving course types

*Traditional-discipline courses*: We could think of these courses as "business as usual" because they do not look too different from past practice. All or most of a subject-specific suite of NCEA achievement standards at the appropriate year level are used to assess learning. Courses are organised around the divisions imposed by the separate standards. These divisions reflect traditional ways of thinking about the structure and content of each discipline or subject within the school curriculum.

*Locally redesigned courses:* These courses take advantage of the modular nature of NCEA. Some combine discipline areas in non-traditional ways (e.g., combining mathematics with music). Others provide a longer time frame for learning (e.g., a 2-year course in Level 1 mathematics). Most courses "cover" less of the traditional curriculum content. This allows for some variation in pacing and the introduction of broader contexts for learning. A mix of achievement and unit standards might be used to assess learning. For example, a course with a focus on sustainable food production might use home economics and sustainability achievement standards with food industry unit standards. In some cases, whole new suites of achievement standards have been designed (see the agribusiness case study below).

*Contextually focused options:* These types of courses have evolved from what would have been called "vocational" or "applied" courses. They make closer links to students' everyday life contexts or to contexts of future work or leisure. Some students experience greater learning success in these courses than they would have with pre-NCEA assessment for qualifications. Assessment is mainly by unit standards. A reduced number of credits might be offered so that students can manageably pace their learning. Students taking these courses are likely to gain most of their NCEA credits from internally assessed standards and there is an emphasis on skills and "doing" rather than pen-and-paper recall of knowledge.

Many courses can be sorted into one or other of these broad course types. All of them can be assessed to award credits towards an NCEA qualification. This means that holding an NCEA award does not, of itself, indicate that specific types of subjects have been studied. The individual "Record of Achievement" is needed to do that.

There were only six secondary schools in the Learning Curves study. This is a small number from which to make generalisations. However, similar patterns of course types were found in the longitudinal Competent Learners study (Wylie, Hodgen, Vaughan, & Hipkins, 2008). Course types were analysed from data gathered when students were aged 16, on the cusp of leaving school. By then they were spread across more than 50 different secondary schools. As we outline shortly, similar course types tend to come together in clusters. These clusters are associated with different "pathways" opportunities. In short, they are signifiers of the likely future options that will be open to students as they transition beyond school.

## Future-focused course innovation

Some senior secondary subjects blur the boundaries between the course types outlined above. These subjects have often been designed with future types of employment in mind. The subject of "graphics and design" provides one example from the Learning Curves study. It has some locally redesigned features (it combines aspects of arts and technology) and some contextually focused features (many students choose this subject with future careers in mind). Graphics and design is assessed with a full suite of its own NCEA achievement standards.

The subject of agribusiness provides a more recent example. Its development and rationale is outlined in the next case study, which draws on correspondence with Peter Hampton, Deputy Headmaster of St Paul's Collegiate School and director of the agribusiness initiative.

## CASE STUDY: Agribusiness as a new subject

Agribusiness is a new type of school subject offered at NCEA Levels 2 and 3, typically corresponding to Year 12 and 13 of schooling.

The rationale for developing the subject describes it as a response to a production shift from commodity-driven, low-value primary goods to high-value products produced via specialised technologies. New types of careers will open up as demand increases for "young people across a wide spectrum of skills—commerce, science, engineering, technology, IT".[6]

The rationale identifies a problematic assumption that work in this field is for less-able students, whereas a strong supply of "academic, tertiary-capable students" is needed to fill the escalating need in the agribusiness industries. The initiative also responds to another problematic assumption that careers in this field are mainly for males (Peter Hampton, personal correspondence).

Agribusiness courses are designed to "expose students to the wide range of skills required and the opportunities available in the primary sector beyond the farm gate" (see website link below). To achieve this aim, the mix of NCEA achievement standards offered for assessment of the intended learning crosses traditional subject boundaries. Seven NCEA achievement standards are organised into four strands: Innovation, Science and Technology, Management and Finance, and Marketing. In traditional curriculum terms these topics would sit in separate subject silos, such as the Science disciplines, Technology, Business Studies, Accounting, and Economics.

The Centre of Excellence maintains and continues to develop the subject. Participation is monitored and students were surveyed by the University of Waikato in both 2017 and 2018. These are the first 2 years of a 5-year longitudinal study of participation. Unpublished data were shared with us for this case study. Uptake is growing rapidly. Ten foundation schools offered the subject in 2017 and 56 schools offered at least some course components in 2018; 2019 data were not yet available at the time of writing. Around 40% of responding students in both 2017 and 2018 were female. Two-thirds of the students surveyed in 2018 ($n$ = 95) said they were likely to choose an agribusiness career. They indicated interest across the wide range of employment options provided by the survey. Three-quarters of them indicated that their school had influenced their choice of agribusiness as a subject.

Unusually for any school subject, development of school-level agribusiness courses was supported by the agribusiness sector, both financially and in terms of identifying sector needs to inform the design process. The 5 years of development to date have cost around $1.5 million, and the Centre of Excellence is looking for another $0.5 million to complete the full course development. Broadly, this has involved designing and testing a pilot programme; developing a well-resourced programme and lobbying for its inclusion in the school curriculum; working through New Zealand Qualifications Authority (NZQA) processes for registering new achievement standards; establishing and maintaining support for schools offering the new subject; and liaising with the tertiary sector to ensure continuity of pathways.

As these two case studies suggest, new types of courses are made possible by the modular design of NCEA. Such courses open up the potential to create new combinations of knowledge and skills that more closely match those identified in discussions about "21st century" learning and capability development. Despite this, the majority of students, including those considered most able, continue to study in traditional-discipline courses. We now turn our attention to these. We focus particularly on mathematics and the sciences, which have traditionally played a strong pathways role in the school-to-tertiary-learning transition.

6 See Centre of Excellence for Agricultural Business and Science—a collaboration between St Paul's Collegiate School, DairyNZ, and Beef and Lamb New Zealand https://www.agribusiness.school.nz/mod/page/view.php?id=683

## Mathematics as an indicator of pathways choices

International studies report that choosing to continue with mathematics is associated with productive post-school pathways, at least for those who do not leave school early. In Scotland, for example, Iannelli and Duta (2018) identify maths as the "significant choice" of later school leavers who stay on productive pathways and describe this as a well-known effect.

Carrying out similar demographic studies in New Zealand would be logistically challenging because of NCEA's flexible design. A subject that is assessed by a traditional examination has reasonably clear boundaries. Teachers can choose the order in which they introduce the prescribed topics but if they leave some out they risk disadvantaging their students. NCEA is different because it is a modular system. Teachers choose from a suite of standards for any one subject. A course rarely covers all the available standards—doing so would be too much for the time allotted in the timetable. If students feel their workload is too heavy, they may choose to "skip" an assessment, which further impacts the mix of assessment standards they actually achieve.

To explore the impact of mathematics course choices on post-school pathways, it is first necessary to confront the different ways subjects can be structured in a flexible modular system. From the very first year of the Learning Curves study, the schools in the sample offered at least two, and often three, variants of mathematics courses at Years 11 and 12. When the research team wanted to research students' subject choices, they had to find out what each maths course was called in each school. They then used those names on a bespoke survey form for each school. Year 13 was somewhat more straightforward because most students who continued to take maths could choose a course with a focus on calculus, or one focused around statistics, or both.

Because the names for each school's maths courses were used in the Learning Curves study, the researchers were able to carry out a cluster analysis of subject combinations, with each type of maths included separately. They found clear patterns in these combinations, with the type of maths course as one of the distinguishing features of each cluster. The analysis revealed eight subject clusters at Year 11, five at Year 12, and just four at Year 13. Table 2 shows the four Year 13 clusters, with a brief commentary about each of them.

The researchers looked back from the four Year 13 clusters to their antecedents in Years 11 and 12. It seemed likely that students choosing a combination along the lines of cluster 4 were already taking alternative maths courses in Years 11 and 12, along with other practically oriented options. Similarly, students choosing an academic combination of subjects in Year 13 were likely to have taken a similar combination in both Years 11 and 12.

**The clustering pattern shown in Table 2 suggests that traditional academic/vocational pathways are broadly set in place by the subject choices made in Year 11.**

The exception to the pattern is the arts-focused cluster in Year 13. There was no equivalent in Years 11 or 12, when students were still taking a range of more traditional courses. Dropping science and maths after Year 12 could be the choice that made the difference here.

TABLE 2 **A cluster analysis of mathematics choices in relation to other subjects**

| Cluster | Indicative subject combinations | Commentary |
|---|---|---|
| 1 (*n* = 80) | Calculus, statistics, physics, chemistry, biology, economics, accounting, history, graphics and design, a traditional English course | Academic students were likely to choose some combination of these traditional-discipline subjects. |
| 2 (*n* = 66) | Statistics, calculus, physics, chemistry, biology, computer studies, economics, English as a second language | This is similar to cluster 1, except that English was replaced by ESOL. Asian students were over-represented in this cluster. |
| 3 (*n* = 80) | Traditional English, history, geography, music, photography, visual arts, drama, graphics and design, art history, classics/Latin, PE, a vocational subject | The arts were strongly represented here, but there were no science or maths subjects. |
| 4 (*n* = 100) | An alternative English course, geography, music, sports, computer studies, information management, media studies, ag/hort, tourism and hospitality, another vocational course | Māori students and Pacific students were over-represented in this cluster, where subjects with a more "alternative" feel were likely to be combined. |

## Choosing STEM subjects

Historically, research on subject choice has focused mostly on science and more recently on STEM subjects (science, technology, mathematics, and engineering) (Mandler, 2017). What is it that sets these subjects apart from the many other choices students might make? There are several possible explanations, which are likely to interact with each other.

- Most visibly, STEM subjects keep a wide range of potential employment options open, in fields that are economically important. This is likely to be the concern of governments when the matter of subject choice is raised.
- Less visibly, STEM subjects have long been used as gatekeepers to ongoing access to education. Students who do not demonstrate their ability to succeed in these subjects are likely to be filtered into different types of study and employment pathways, maybe even before they reach the senior secondary school. From the perspective of the sociology of knowledge, mathematics and the physical sciences have a different knowledge structure to the humanities (Bernstein, 1999).[7] They are said to be structured vertically. Progress to next stages depends on mastery of foundation ideas and the specialised "grammar" of the relevant discipline. By contrast, making progress in horizontally structured subjects essentially entails exploration of new and more demanding contexts as knowledge accumulates. It is not difficult to imagine how vertical knowledge structures become effective gatekeepers of further learning progress.

In New Zealand, the Staying in Science project (Hipkins & Bolstad, 2005) explored concerns that declining numbers of young people were choosing a tertiary education in the sciences with a view to taking up science careers. It found that in Australia, there had been a steady decline in enrolments in all three traditional science disciplines (biology, chemistry, physics) from the late 1970s to the early 2000s. It was commonly believed that the same pattern would pertain in New Zealand, which is why the Ministry of Research, Science and Technology (MORST) commissioned the research. However, the researchers described multiple different ways to measure participation, each with the potential to come to somewhat different conclusions. Even so, they found that greater proportions of students were opting out of sciences

7 A sociologist of knowledge, Basil Bernstein, wrote the much-cited paper that underpins this field (Bernstein, 1999). The Learning Curves team also drew on Bernstein's ideas when they named the subject "types" in the Learning Curves project.

in the senior secondary school in New Zealand compared with mid-20th century participation patterns. They pointed out that "these trends need to be set against a context of expanding school rolls at the senior level, with an attendant proliferation of different types of courses. Science faces more competition than in the past!" (Hipkins & Bolstad, 2005, p. 40). The complexity of influences on these choices will be discussed in Section 4.

### Indications of post-school science choices

Staying in Science had been based on a literature review. In 2005, MORST funded a follow-up study, which was empirical. It investigated the intended post-school study choices of students who were still taking science subjects in Year 13. Via surveys and focus groups, students indicated their ongoing study plans and reasoning for these choices (Hipkins, Roberts, Bolstad, & Ferral, 2006). A cluster analysis of the subjects they had combined in Year 13 revealed several distinct groups who were each thinking quite differently about their plans.

**Serious science students** made up a third of the overall sample. They were taking mainly STEM subjects in Year 13 and were headed to university with thoughts of becoming doctors, dentists, or vets. Very few were contemplating research science careers.

**Science business students** made up a quarter of the sample. They were mostly male and were taking combinations of maths, physics, and/or chemistry with IT, economics, and accounting subjects. These students tended to say they wanted to pursue careers in business rather than science because these business-type roles would pay more.

**Keeping options open (1)** was a female-dominated group that made up a quarter of the sample. These students were still taking at least one science subject in Year 13, combined with English. The science subject was more likely to be biology or an "alternative" subject such as agriculture/horticulture and students were less likely to still be taking maths. These students were less likely to anticipate success in ongoing science learning and were leaning towards other types of pathways. The researchers called this cluster "keeping options open" because that's what students in the focus groups told them they were doing when they continued with at least one science choice at Year 13.

**Keeping options open (2)** was a male-dominated group. The students in this group were more likely to be taking ESOL than English, and to combine one of the alternative science choices with economics or accounting. These students were also keeping their options open but were not intending to follow a STEM career pathway.

One interesting insight from this work is that the "serious science" students and the "science business" students had the potential to access a much wider range of career options than they seemed to be aware of. This is one of the challenges that the agribusiness initiative explicitly aims to address. The finding also suggests the importance of effective careers advice, which is a challenge we discuss in Section 5.

## Indications of systemic influences on potential future success

This section has suggested that *subject combinations*, rather than individual subjects per se, can be useful indicators of likely future study or work trajectories in the New Zealand system. The similarity of subject clusters in diverse secondary schools points to systemic influences on ways that students navigate and make sense of their choices within the complexities of the education system as a whole. The next section will elaborate on such influences, including the ways in which timetable structures accommodate likely choices, alongside assumptions key adults might make about who students "are" as learners and future citizens. Before leaving this section, another important systemic influence on students' clustering choices must be briefly outlined.

## University Entrance as a key systemic influence

University Entrance (UE) determines whether students will be able to transition to university study. Over and above gaining NCEA Level 3, students must satisfy the following conditions to be awarded UE:

- They must gain at least 14 credits in each of three subjects that are "approved" for this purpose by NZQA in consultation with Universities New Zealand. Traditional academic subjects feature strongly, but some non-traditional subjects are also included.[8]
- They must gain at least 10 credits at Level 2 or above that demonstrate their literacy capabilities (5 credits in reading; 5 credits in writing).
- They must demonstrate numeracy capabilities by gaining 10 or more Level 1 credits either from specified achievement standards that assess an aspect of numeracy (e.g., a specific science standard that requires use of mathematical formulae to solve problems) or from a package of three numeracy unit standards, all of which must be achieved.[9]

The list of approved subjects is not totally fixed: there is a process that can be followed to get additional subjects approved. The overall intent is to ensure that credits that count towards UE come from academically challenging courses. However, this requirement also has the effect of limiting the potential for flexibility in course design outlined above.

Section 4 reports on research that shows some students find university pathways blocked to them because they get Level 3 NCEA but do not get UE. This might be because their credits are not distributed across approved subjects in the correct way, or because they do not satisfy the literacy or numeracy requirements, or because of some combination of these factors. Of course, many students who get UE are then faced with competition for places in limited-entry university courses. In these cases, universities typically use students' Achieved/Merit/Excellence profiles to create grade point averages (GPAs) to rank them. In this way, high achievement helps keep pathways open in New Zealand, as it does in other nations.

8 The full list of approved subjects is here: https://www.nzqa.govt.nz/qualifications-standards/awards/university-entrance/approved-subjects/

9 For more information, see https://www.nzqa.govt.nz/qualifications-standards/awards/university-entrance/

4.

# How students choose (and what gets chosen for them)

This section focuses on students as choosers of subjects and pathways, within systemic constraints that they may or may not be aware of.

How the idea of "choice" is understood can depend on the theoretical framing used to explain the patterns found in empirical studies. Peter Mandler is an historian who recently documented trends in subject-choice research in the UK, spanning the years from just after the Second World War up to the present (Mandler, 2017). He noted that psychologists tend to "pin subject choice on personality type" (p. 2), while economists "attribute subject choice to rational behaviours based on future earnings" (p. 3). Sociologists tend to see subject choice as a myth, given indications that sorting practices tend to be based on gender and social class. Mandler also noted that studies based on student surveys often don't dig deeply into what drives students' self-perceptions and "tend to conclude with homilies about the need for more information and better guidance" (p. 2).

The cluster analyses described in Section 3 incline to the sociological perspective.[10] However, things are not that simple. Mandler's own analysis shows how a complex mix of theoretical perspectives can be deployed to explain patterns in the ways students make choices. The next case study illustrates this jumble of influences in the context of choosing to continue studying sciences.

10 The analysis of subject types is explicitly based on a theoretical framework proposed by Basil Bernstein, a sociologist of knowledge structures.

## CASE STUDY: The "swing away from science" in the UK context

Since the late 1960s, subject-choice research in the UK has been dominated by a focus on science, and more recently on STEM (Mandler, 2017). Across that time, until just after the 2008 financial crash, participation in those subjects was steadily declining despite numerous policy initiatives intended to boost it. The research literature gives a range of reasons:

- **Disillusionment:** Young people became disillusioned with science and technology, at least from the 1960s on.
- **A cohort effect:** As A-level and higher education opportunities expanded rapidly, less-academic students stayed longer in secondary school. Research has shown that these students perceived English, geography, and history to be easier subjects and maths, physics, and chemistry to be harder subjects.
- **Parents' influence:** The cohort who might once have left school earlier came from families with minimal or no experience of the graduate labour market, which in any case was changing very rapidly. In these uncertain conditions, student and parent thinking about subject choices followed the traditional influences of interest, enjoyment, and prior attainment.
- **Gender:** This provided another cohort effect—girls favoured the "softer sciences" (e.g., biology) and the arts subjects. (Hipkins and Bolstad (2005) also reported this gender effect in the Staying in Science research.)
- **A changing labour market effect:** Post-industrial shifts have moved from technologically oriented employment towards expansion in the public sector, the helping professions, and retail and management. These new types of occupations are "more neutral as to subject choice" (Mandler, 2017, p. 12), which means that students can "swing away from science without losing ground in the labour market" (Mandler, 2017, p. 12).

Mandler says these trends meant that by the 1970s, universities were more oriented to student demand, supporting students to follow their interests, abilities, or perceived vocations. Initially, the humanities were the beneficiaries of the swing, and indeed were the only real alternative in the senior secondary school. But new subjects were being introduced at A-level: "Most of the popular new subjects fell into an entirely new area, allegedly between arts and sciences, which became known as 'social studies', including Economics, Sociology, and Business" (Mandler, 2017, p. 17). There was also a lesser swing to the Creative Arts. These new courses were not specific about needing to have A-levels in either humanities or sciences, so they were free to recruit from both types of school courses.

Mandler describes the post-2008 slump as the "sting in the tail" (p. 24) of the story of the decades-long swing away from science. Those positioned at the lower end of the graduate pool found themselves disadvantaged in a contracting economy. They were over-educated for the available work and at the same time tuition fees rose sharply. Thus, potential graduate earnings became a political focus, not just a personal one. All those loans to be paid back! Once again, rhetoric about the benefits of choosing STEM subjects to keep options open entered the public discourse. Mandler argues that this rhetoric might work to increase STEM participation given the "triple whammy" of the employment slump, the rise in fees, and a "concerted propaganda campaign" (p. 24). However, he says it is too soon to tell.

Since 2012, the swing away from science in the UK has at least halted and may have even gone into reverse (as at 2017). However, Mandler worries that, with the exception of medicine, the economic rewards might not follow. This is because "subject choice does not seem to make much of a difference to returns to education" (p. 25). He says that choice of university is more important, and also that economic rewards might actually be "rewards to other characteristics, notably the generic analytic skills associated with 'graduateness' and the behavioural characteristics associated with class" (p. 25). In this context, he worries that widening STEM participation will further disadvantage students from poorer backgrounds if they cannot find STEM employment.

This case study highlights the complex mix of influences in play as students (and parents) make choices that they might perceive to be entirely or mostly their own. These influences include:

- students' personal interests, enjoyment, and current achievement patterns
- student and whānau perceptions of future employment opportunities and their likely financial returns
- the types of careers that students can already envisage and see themselves following
- the options offered by the school (more on this shortly)

- the transition options that seem realistic to students and their whānau (i.e., where they have a chance of being accepted for tertiary study)
- PR campaigns designed to attract attention to certain types of opportunities, based on perceived economic needs.

The following quote from Staying in Science also highlights the complexity of interacting factors in play as students make their subject choices:

> International studies of students' subject choice decisions in the last few years of secondary school suggest first, that there is a great deal of variation in how young people make their subject choices and educational decisions. Secondly, they also suggest that these decisions involve a complex mix of psychological and social factors, and often it is the interaction between these factors that is important in shaping students' choices and decisions. Thirdly, students' personal and family worlds seem to be an important influence on their choices. Notwithstanding these complexities, existing research suggests two areas that seem to be particularly important in students' choice to continue or not to continue with science. These are: students' experiences with school science; and their knowledge and awareness of the range of study and career options that involve science. (Hipkins & Bolstad, 2005, pp. vi–vii)

The age-16 phase of the longitudinal Competent Children/Competent Learners study also pointed to the influence of family background. The researchers reported that structural constraints around career and pathways choices included "maternal qualifications, family income at age 16, ethnicity, and subject cluster" (Vaughan, 2008, p. 66).

## How socioeconomic differences between schools impact on choices

Mandler's research and the Staying in Science research both reported that students' and parents' familiarity with employment opportunities influences choices. What about the school context itself? Anders et al. (2018) drew on data from England's National Student Database to report that the school attended explained around a quarter of the variance in the academic selectivity[11] of subjects chosen, once demographics had been accounted for. They suggested that "schools might try to offer a curriculum which they deem appropriate for the socioeconomic composition of the school" (p. 89) and that "schools serving poor children face difficulties in recruiting and retaining highly qualified staff" (p. 89), especially in areas of teacher shortage such as languages and science. They also noted that students were less likely to study applied subjects if the overall school intake was higher ability. Students in boys' schools were more likely to take "triple sciences" than the equivalent cohorts in girls' schools. However, in general, students in single-sex schools were more likely to be taking an academically selective set of subjects.

The explanations offered by Anders et al. (2018) highlight the multiple potential factors that can come together in different school contexts to impact students' choices. These include the school's perception of types of subjects that will be appropriate for their students; the influence of peers, including the overall academic ability of the cohort; gender; and the availability of teaching staff for various subjects.

In New Zealand, low-decile schools mostly draw students from low socioeconomic backgrounds, while students from more prosperous families typically attend higher-decile schools. How might these differences impact choices? Whether high or low decile, most New Zealand secondary schools try to cater for all types of student pathways. Thus, the impacts described by Anders et al. might be less obvious at the whole-school level. Nevertheless, there is clear evidence that, for some groups of students, all these influences are likely to apply. The next case study is set in low-decile schools that cater for greater numbers of students from low socioeconomic backgrounds.

11 Anders et al. use "academic selectivity" to mean subjects that keep students on pathways to university study.

## CASE STUDY: The Starpath research programme

Starpath was an extended study of students' subject choices and pathways, centred on low-decile schools in Northland and Auckland. The website that hosts the research outputs[12] describes the programme as "focused on equitable outcomes for New Zealand students who have been under-represented in tertiary education".

Quantitative surveys carried out early in the work programme showed that Māori and Pacific students, many of whom attend low-decile schools, tended to be enrolled in less academic subjects. Their achievement tended to be assessed by unit standards rather than achievement standards and they completed fewer credits from the approved list of UE subjects (see Section 3). The researchers could see that these patterns placed students at risk of not achieving UE, or of achieving at a level that would likely exclude them from limited-entry university programmes.

A fundamental underpinning belief of the Starpath team was that many students in these low-decile schools had the ability and potential to succeed in degree-level qualifications. They noted that:

> These inequities pose a major challenge, and not only for young people from Māori, Pacific and low income families and their parents. According to international studies, there is a strong correlation between educational qualifications, long-term employment and life-long earnings, and Māori, Pacific and children from low income backgrounds comprise a rapidly increasing proportion of the youth population (and hence the future workforce) in New Zealand. If relatively few of these young people acquire degree level qualifications (and particularly University degrees, which attract a premium in life-long earnings), the country's prospects of sustaining a high income, high value economy into the future are significantly diminished. (Madjar, McKinley, Jensen, & Van Der Merwe, 2009, p. 3)

The researchers undertook a qualitative study called Towards University to explore the choices made by students in five low-decile schools. Semi-structured interviews were carried out with 87 students, 42 parents, and 32 teachers. As anticipated, the researchers found many of the students they interviewed were not on track to achieve UE, even if they aspired to go to university. Within the flexibility offered by NCEA, too many students made choices that did not meet the specific conditions needed to obtain UE. Hence, they had inadvertently closed pathways to university study.

**The researchers concluded that the lack of emphasis on UE as a goal to be aspired to was impeding opportunities for transitioning to university from low-decile schools.**

The research team also recognised that "authentic relationships between school and whānau, focused on student learning, are a crucial lever enabling Māori and Pasifika student success" (Webber et al., 2018, p. 8). They had acted on this advice themselves, using case-study data to write a book for students and parents that explained the consequences of NCEA choices in clear, simple language (McKinley & Madjar, 2013). They also switched focus to support and strengthen academic counselling programmes in low-decile schools. Their research outputs include a toolkit for schools to use when making changes to overall timetable and support structures for students (available via the website).

Whānau and students' lack of familiarity with university life and opportunities was another focus of the Starpath programme. Researchers said that universities should play their part in helping students make good subject choices by showing them clear pathways from school, through university, and into employment options (Webber et al., 2018, p. 79).

An over-emphasis on gaining credits is one aspect of NCEA that has possibly misled less-savvy students into thinking their options were more open than they actually were. The Learning Curves and Competent Learners projects showed that, in the early years of NCEA, academic students saw high credit totals as one way of setting themselves apart from lower-achieving students. An unfortunate consequence was the development of a "credit hunting" rationale for learning at the expense of deep engagement with the substance of the curriculum, including opportunities for capability development. The recent public consultation around changes to NCEA has made it clear that this is still an issue that needs to be addressed (New Zealand Council for Educational Research, 2018).

12 http://www.education.auckland.ac.nz/en/about/research/starpath-home.html

## How school timetabling practices constrain choices

The issue of constrained subject choices is not restricted to low-decile schools. The Learning Curves schools spanned a range of deciles, yet the very first report described how timetabling practices common to all of them acted to constrain choices for some students (Hipkins & Vaughan, 2002). These constraints are related to how the traditional timetable structure divides the school day into "several blocks of time of similar length, during which discrete subjects are taught by specialist teachers" (Brady, 2006). This chunking of time[13] mediates the enacted curriculum and the use of allocated spaces in the school. Brady goes further, saying it also mediates teachers' work and identities, and directly impacts student learning.

Most secondary schools make considerable efforts to build a timetable that caters for the needs of as many students as possible. As Section 3 outlines, "academic" students tend to choose a combination of traditional academic subjects. These "approved" subjects are important when it comes to gaining the UE qualification. They must be distributed across the lines of the timetable in a manner that creates the fewest clashes for the greatest number of students. Other types of subjects then tend to be slotted in as alternative choices to traditional subjects. In this way, the organisation of the timetable creates constraints that lead to clustering of similar types of subjects (see Section 3). These constraints might be compounded by advice given to students who do not fit readily into well-trodden pathways. The Learning Curves study reported that deans had a strong influence on the choices some students made. Their advice was shaped by what they thought harder-to-place students were capable of achieving, regardless of whether or not these students were actually interested in the subject being suggested (Hipkins, Vaughan, Beals, & Ferral, 2004).

In the 2018 National Survey of Secondary Schools, almost half of the principals and over a third of the teachers identified timetabling to support a growing range of student learning opportunities as a major issue facing their school (Bonne & MacDonald, 2019). The researchers commented that "secondary schools are increasingly being expected to develop timetables that enable a diversity of learning pathways, making this a complex logistical task" (p. 52).

Education for the 21st century adds additional layers to these complexities. For example, the growth of "vocational pathway" programmes requires collaboration with community groups, including potential employers. The time that students are away from school is not easily accommodated given the timetable structure of discrete learning periods. Students gain valuable experience but miss out on other learning being offered in their absence (Vaughan & Keneally, 2003). Secondary–tertiary programmes or Trades Academies might be enabled or constrained by how readily their time requirements can be accommodated alongside more traditional timetable arrangements.

## Students as active choosers

So far, this section has positioned student choices within a web of constraints, which students themselves may or may not be aware of. The age 16 round of the Competent Learners study highlighted multiple ways in which each student's fit with school (or not) impacts on the choices they actively envision for themselves:

> ... students who do well in the areas most valued by teachers and schools (e.g. enjoyment of reading, being focused and responsbile, high cognitive competency) are consistently more likely to see themselves undertaking tertiary study, often university, having professional occupations, and fewer barriers to the life they desire. In short, they are more likely to have a learning identity that predisposes

13 In New Zealand schools, the length of each "period" in the school day can vary. Some schools have shorter periods, and hence fit more of them in the day (e.g., 40–45 minutes). Some have longer learning periods (e.g., 90 minutes) and hence can fit fewer periods into each school day. The actual amount of allocated learning time per subject is likely to be similar.

> them to undertake tertiary study in the first year of leaving school, and possibly undertake more formal learning later in life too. (Vaughan, 2008, p. 67)

An Australian research team investigated relationships between subject choices for the final 3 years of school, made when students were aged 14–15, and their vocational interests, self-efficacy beliefs,[14] and academic achievement (Patrick, Care, & Ainley, 2011). They identified three main ways in which these influences interacted to predict the actual choices students made:

- Choices of "artistic, social, conventional students" were best predicted by academic achievement.
- Choices of "realistic students" were best predicted by a combination of self-efficacy beliefs and vocational interests.
- Choices of "investigative students" were best predicted by self-efficacy beliefs and academic achievement.

The researchers said these findings contributed to "an understanding of the *complexities of the antecedents of choice* of educational pathways by *stepping outside the mathematics/sciences field* to look at other vocational themes" (p. 72, emphases added). A complex mix of personal influences on students' choice-making comes into view here.

A UK-based study presents a different perspective on students who actively buck the system yet continue to thrive (Thomson, Hall, Earl, & Geppert, 2018). These students chose to continue with arts subjects despite these subjects' lack of E Bacc status. The students were not only focused on future pathways when they chose these arts subjects. The researchers positioned these choices as acts of "resistance" to the status quo. They said students valued the arts for the benefits they gained in their daily lives, and attributed those benefits to the ways in which arts subjects are taught (their innovative pedagogies). They asserted that this research opens up a new perspective on subject choice. Further research on this perspective is needed because it points the way to potential avenues for reform of traditional school systems. We found no equivalent research in the New Zealand context.

14 The idea of self-efficacy (Bandura, 1997) refers to a person's self-belief about what they might be competent to do. When people envision their likely future performance, they take into account past and current successes and failures.

# 5.
# Keeping options open

In this section, we come to another question at the heart of the review. How might students best be supported to keep future study and work options open in the face of rapidly changing employment, social, and environmental/life contexts?

The conventional thinking about keeping options open is that students will choose a range of subjects that leave multiple work and career possibilities in play for as long as possible. The idea seems intuitively appealing in the context of an unknown future where the nature of work, the conditions of work, and the purpose of work are all changing quickly and unpredictably. How could anyone be definitive in their choice of a path or career, knowing it might be gone or look quite different by the time they arrived? Keeping options open seems like a good strategy.

Previous sections have painted a clear picture of complex and interacting influences on students' subject choices. Given this complexity, it should not be surprising that the very idea of keeping options open can also be understood in different ways, with differing implications for future action. In this section, we explore the idea in the light of the findings reported in Sections 3 and 4.

## Keeping options open as subject boundaries change

Section 3 explored NCEA's potential for remixing of old subjects and the introduction of new subjects in the senior secondary school. As new subjects emerge at the intersection of disciplines, "keeping options open" starts to change its meaning.

The conventional model is that school subjects map to careers and tertiary-level education or training: for example, STEM subjects lead to STEM careers. This assumes that disciplinary boundaries between subjects are reasonably clear and so are the types of work the subjects lead to. A related assumption is that some students are academically inclined while others are not.

Section 4 outlined how these interacting assumptions are deeply embedded in the DNA of conventional schooling and are reflected by influences such as timetable structures, guidance advice about subject choices, and regulations related to gaining qualifications (especially UE). Table 3 below summarises ways these influences align in the familiar model of traditional schooling.

TABLE 3 **Alignment between aspects of conventional schooling and work**

| | |
|---|---|
| **Traditional curriculum** | A common core of school subjects was developed in the 20th century, with input from disciplines and industries. |
| **Familiar timetable arrangements** | Subjects are grouped and timetabled and offered to students according to their perceived abilities.<br>Different pathways are typically made clear through the prospectus and there may be associated guidance. |
| **Students as agentic choosers** | Students choose their subjects/pathways from an increasing number of possible options. (Core subjects, which are compulsory, limit choices in Years 9 and 10.)<br>Guidance structures may help. Families influence. |
| **Conventional transitions** | Students make transitions into work and/or formal learning following subject interests and achievement.<br>Some pathways have prerequisites that influenced earlier choices. |
| **Successful working life** | Successful tertiary education leads to establishment of long-term careers. |

This conventional alignment is increasingly challenged as different kinds of jobs arise, knowledge bases change, and interdisciplinary subjects emerge. As one example, the concept of keeping options open cannot be straightforwardly applied in the agribusiness context. On the one hand, students would be more likely to choose this subject if they *already* had a strong interest in the primary sector—in which case their options could be seen to be narrowing. On the other hand, there are many different fields of agribusiness in New Zealand and many different employment opportunities within each field. In this sense, choosing to study agribusiness could be seen as keeping options wide open. Within the bounded choices created when the subject is chosen, many different future possibilities open up. In this complex context, every agribusiness teacher is encouraged to see themselves as a careers adviser (Peter Hampton, St Paul's Collegiate, personal correspondence).

## Keeping options open as an individual choice

The potential meaning of keeping options open shifts in several ways when we consider students as individual choice-makers. There are interesting tensions between the idea of keeping options open, framed as being about capabilities and inclinations at an individual level, and the actual subject choices that might be available. As Section 4 outlined, the subject choices of individuals are mediated by structures and processes that might not be visible to them. A student might, for example, ask for a "mismatched" combination of subjects that is precluded by timetabling assumptions about types of students (perceptions of ability and interests) and their likely intentions.

As a hypothetical example, even if new subjects like agribusiness do not (yet) exist, a student might hope to choose combinations of subjects that approximate this avenue of work (e.g., horticulture and accounting). In this case, subject choices that appear to be unrelated might indicate a specific career intention (e.g., to manage a nursery). What appears to be a misguided case of keeping options open by making scattered choices might actually indicate a more purposeful pathway. As the research outlined in this section shows, it is important to check students' reasoning about their choices before making assumptions about what these indicate. This comment points to the importance of ensuring that every student can access academic counselling. How best to provide such counselling was one line of inquiry—and follow-up action—in the Starpath research.

The idea of keeping options open could be seen as a privilege extended only to high-achieving secondary school students. As Section 4 outlined, timetable structures are designed to ensure coherence in the

choices academically able students make, while giving them as much opportunity as possible to follow their interests and passions. By contrast, the Starpath research found that students who are not seen to be academic don't necessarily realise they are closing options down if they do not receive—and act on—robust advice about the consequences of the subject choices they make. Specifically, options for university study will be closed to them if they do not gain UE. Yet, as the Starpath researchers pointed out, many of these students have the potential to succeed at university. As a nation, we need them to do so for our future economic prosperity (Madjar et al., 2009). The privileging of individual agency is misaligned with structural processes and constraints in this context.

The 4-year Pathways and Prospects research involved 120 young people who were on six different post-school pathways (Vaughan, Roberts, & Gardiner, 2006). For some of these young people, keeping options open was a deliberate strategy they hoped would create a form of security in life in their immediate post-school years. The researchers called this group "confident explorers". The defining characteristic of the group was a strong sense of purpose in following up multiple different interests without cultivating a specific career identity. Their approach was not to guard against change and uncertainty but rather to embrace uncertainty by turning themselves into an enterprise through an ever-growing portfolio of different possibilities and paths. However, a follow-up paper 2 years later reported that this "confident explorer" approach no longer stood out in the same way it did when students first made the transition away from school (Vaughan, 2010).

Staying in Science found, somewhat ironically, that the students who potentially had the widest range of options open to them (i.e., "serious science" and "science business" students) already had clear ideas about what they wanted to do with their lives. At least for the "serious science" students, the choices they envisaged were for conventional careers in health-related fields (Hipkins et al., 2006). The students who said they were "keeping options open" were actually more undecided about their futures. Because their subject choices in the final year of school were more eclectic and scattered, they were potentially at risk of not making clear pathways choices at all.

In both the Staying in Science and Pathways and Prospects research, the individual's sense of keeping options open seems to act as something of an insurance policy against an unknowable future. However, as Mandler pointed out in his study of STEM choices, there are financial consequences if this strategy does not pan out (Mandler, 2017). Tuition fees have escalated in recent years and there is an assumption that the costs of study will be covered by future earnings. In a constrained labour market this might not eventuate. Mandler concludes that, all things considered, less-academic students are better off when they are encouraged to follow their interests and strengths rather than second-guess successful post-university careers. The age 26 phase of the longitudinal Competent Children/Competent Learners project reached similar conclusions in the New Zealand context. The researchers noted that "the high cost of post-school qualifications is an added penalty for those who choose courses that do not lead to good work options" (Wylie & Vaughan, 2019, p. 51). Looking back, many of these young adults wished they had been more open to following their personal interests, had explored more options, and had been given better careers advice.

Mandler's argument also has interesting resonances with a renewed focus on the importance of vocational pathways. Here in New Zealand, this is reflected in the recent introduction of a Prime Minister's prize for excellence in achievement on a vocational pathway. When the prize was announced, the Prime Minister was reported as commenting that "for too long trades and on-the-job skills training has played second fiddle in how we see success at school and later career choices" and that "going to university will always be a great way to further your career but vocational careers are equally as important, particularly given the huge skills shortages that exist across many industry sectors".[15]

15 https://educationcentral.co.nz/prime-ministers-vocational-excellence-awards-launched/

It is too soon to say what the impact of this initiative might be. The pertinent point for this review is that it is an indicator of shifting thinking about the relative importance of different types of pathways. As we next outline, other recent pathways initiatives also point to the importance of supporting more diverse choices.

## Vocational pathways to keep options open

The idea of pathways was designed to address mismatches between subjects/achievement and tertiary learning and careers, with an emphasis on vocational opportunities. The intention is to help prevent students from making subject choices that inadvertently narrow or preclude post-school learning and/or work options.

Several types of initiatives are grouped under the broad policy heading of "Youth Guarantee":[16]

- **Vocational pathways tools:** These include "maps" of NCEA standards that contribute to six industry-related vocational pathways: Creative Industries, Primary Industries, Service Industries, Social and Community Services, Construction and Infrastructure, and Manufacturing and Technology.[17] The maps are intended to guide individual choice-making, but can also help schools to ensure that timetable designs help vocational students make more coherent choices.
- **Secondary–tertiary pathways programmes (STP):** These are collaborations between schools and Tertiary Education Organisations (TEOs). Their aim is to give students clarity and career direction through focused learning programmes based on specific groupings of subject choices. STP programmes cover a range of different activities depending on the area of focus and collaboration partners. They typically involve combinations of TEOs, Industry Training Organisations (ITOs), employers, and schools.
- **Trades or health academies:** These are a specific type of STP. They operate as partnerships between schools and tertiary providers. Students typically attend the academy 1 day a week and school-as-usual the other 4 days. They provide learning programmes aimed at broad industry areas and are distinguished from mainstream secondary-school learning by the out-of-school setting, by the contexts they use for learning, and by the establishment of an academy cohort who study all their subjects together.

In 2015, ERO evaluated 15 of the 24 Trades Academies. They concluded that these initiatives were generally successful in keeping target students on productive learning pathways:

> ERO found that the curriculum of the STPs was relevant to most students and its delivery engaged and motivated them. This was instrumental in changing their attitudes to learning and enabled them to see themselves as capable learners. Students developed key skills and competencies in the programmes offered by the STPs and gained an appreciation of the expectations relating to tertiary study and the requirements of a workplace. They understood the value of the theory behind their practical work and that qualifications provided them with opportunities for the future. Students were well supported by teachers at school and the tutors at the tertiary organisations. They generally developed a clear learning pathway which gave them a sense of purpose. Most students experienced positive transitions to further education, training or work. (Education Review Office, 2015, p. 2)

Areas ERO saw for improvement included ensuring that the secondary and tertiary learning components complemented each other, and that the partner organisations worked together to better align their student management systems, structures, and reporting practices.

In 2014, the Ministry of Education also evaluated the impact of STPs, which were first introduced in 2011 (Earle, 2018). Earle concluded that:

16 http://youthguarantee.education.govt.nz/
17 http://youthguarantee.education.govt.nz/initiatives/vocational-pathways/

> While participants were more likely to achieve NCEA Level 2 or equivalent than young people with a similar background, participants were no more likely to progress to Level 4 and above tertiary education (including through industry training). Secondary–Tertiary Programmes have been particularly effective in providing pathways to full employment. This has resulted in higher average earnings for participants, compared to young people with a similar background. (p. 1)

Earle reported that the following demographic groups were most likely to benefit by making employment gains: males, students from Pacific Island backgrounds, those with no prior NCEA qualification, those with higher education performance, and those at lower risk of poor outcomes. Female and Māori students did not show the same employment gains. There are echoes here of the gender differences reported in research on more traditional subject choices. For example, in the British context, Moulton, Sullivan, Henderson, and Anders (2018) noted that taking an "alternative" (i.e., not E Bacc) pathway was more likely to disadvantage girls than boys, causing them to "leak" out of the education pipeline. They explained this effect by saying that choosing alternative subjects seemed to hamper girls' access to A-level courses more than boys' access. Earle's research suggests there is more to the gender effect than subject choice alone. This could bear further investigation.

## Alternative pathways arrangements

Alternative pathways arrangements make learning programmes accessible to people without the knowledge or skills normally required. They either backfill people's knowledge and achievement through "bridging" courses, or they give special dispensation to enter the programme and provide additional learning support along the way.

Some bridging courses are broad and designed to prepare people for tertiary-level education: for example, the University of Waikato's Certificate of University Preparation. Some bridging programmes are "pre-vocational" (often "pre-trades") and designed to provide a "leg up" and some basic skills and confidence for learners interested in undertaking an apprenticeship but lacking familiarity with trades work. Some alternative pathways arrangements are driven by workforce shortages, which provide an incentive for industries to look further afield. In the process, employers might be confronted with a need to address diversity issues.

Some initiatives combine several of the above elements, as the next case study illustrates.

### Pathways into engineering: A case study of one way to bring diverse initiatives together

This case study illustrates how a deliberate and focused co-ordination of pathways initiatives can provide a proactive response to a mismatch between subject choice at the school level, pathways initiatives, and anticipated workforce needs.

Engineering e2e originated in the Government response to a National Engineering Education Plan (NEEP) project funded by the Tertiary Education Commission (TEC) in 2008. The NEEP project considered engineering pathways from school and through tertiary learning, engineering qualifications, and co-ordination of tertiary education providers. In 2010, it reported the estimated demand for—and supply of—engineers, and future demand for engineering graduates, based on data from the former Department of Labour, the Ministry of Education, the OECD, and feedback from industry (NEEP Project Governing Group, 2010).

The report showed shortfalls in the number of engineers needed for two different scenarios—one for business-as-usual and one for an innovation-led economy with links to future-of-work trends. It recommended ongoing work between ITOs, the Ministry of Education, and the TEC to develop school-to-employment pathways. In response, the Government allocated funding to increase the number of engineering graduates.

Further reports revealed that secondary students who aspired to engineering were not well prepared for tertiary learning because their chosen school subjects did not allow them to meet entry criteria, they were unprepared for learning at tertiary level, and they did not know about engineering work and career options (Research First, 2014; Tertiary Education Commission, 2013). Two further reports examined ways to increase the numbers of engineering technology students through more flexible programme entry for those not meeting programme entry prerequisites (Ako Aotearoa, 2014a) and to support greater collaboration between engineering education providers and their local secondary schools, to produce modular and bridging courses for secondary and tertiary students (Ako Aotearoa, 2014b).

An evaluation of these efforts carried out in late 2017 reported that the initiative had succeeded in meeting targets for increased numbers of engineers entering the workforce (Vaughan, 2018). One caveat to this success was that not enough of these recruits had graduated from degree-level engineering courses.

Vaughan's report described the Engineering e2e initiative as a "systems integrator" (p. 11) that took a "workforce development approach", co-ordinating individual opportunities, organisational goals, and national priorities for economic growth. This was contrasted with other initiatives that might take a "career development approach" focused on provision of information to support individual decision making (p. 13).

The evaluation reported on participants' perceptions of the advantages of a workforce development approach. These included helping everyone to see the bigger picture and imagine different ways of working; building stronger relationships across sectors and groups; and being free to explore new ideas, given a mandate for collaborative change. There was, however, some criticism that the compulsory school sector was not represented as strongly as it should have been. Participants were mainly drawn from the tertiary sector, where the funding was also sourced.

## Careers advice in changing times

In the early 20th century, vocational guidance emerged to deal with industrial expansion, intensifying immigration, and occupational diversification. The family and neighbourhood were no longer the primary source of information or means of job allocation.

Marketing campaigns continue a traditional information-giving focus into the 21st century. These campaigns are designed to raise awareness about specific careers and entry requirements, often including reference to the appropriate secondary school subject choices. Campaigns are typically proactive in nature, aiming to influence students, families and whānau, and teachers (especially careers advisers) before or at the points of choice-making. Examples of these campaigns include Make the World (for engineering) and Got a Trade? Got it Made! (for trades).

In the second half of the 20th century, the focus of careers advice shifted to careers counselling for helping manage the relationship between work and education, and integration with other life roles (e.g., family, community). In the 21st century, career development needs to address diverse and mobile populations of people of any age, as they make decisions about education and work *throughout* life and manage their careers (careers that used to be managed by their company/organisation). The idea of "career management competencies" arose as a response to this context of uncertainty and constant change (Vaughan, 2011). Vaughan saw potential for the idea of career management competencies to align with the key competencies of *NZC* (see Section 2). There was a tension, however, because an emphasis on fostering competencies/capabilities is the domain of subject teachers rather than careers advisers.

Academic counselling has potential as one specific way to address these ongoing challenges. As Section 4 outlined, there are immediate and practical needs for such counselling when students make their choices of subjects in the senior secondary school. Choices have consequences and these are not necessarily visible in advance, especially given the complexity and flexibility of the qualifications system. Individual choicemaking is also influenced by a complex mix of factors. Many students could benefit from help to identify and clarify their personal interests, strengths, goals, and potential pathways. Arguably, such activities would continue to stand students in good stead as they move into their post-school years.

It is important to stress that counselling and advice are needed by *all* students, not just those at risk of making poor decisions. Looking back from age 26 at the pathways taken by the Competent Learner cohort, Wylie and Vaughan (2019) recently commented: "Even a 'well-lit path'[18] from school into adulthood has to be made by each individual; the paths are often not straightforward, and rely on continual openness and learning" (p. 3).

18 By this they mean that young people follow a traditional pathway from school into tertiary study and on into employment, as outlined in Table 3.

# 6.
# Short answers to big questions

This report has addressed the question of ways in which the subject-choice systems of secondary schools, and students' actual subject choices within those systems, position New Zealand's young people to be capable of undertaking the sorts of work predicted by futures thinkers. This is a complex question that implicates a number of sub-questions. This final section summarises the discussion from previous sections to provide succinct answers to these sub-questions.

**Do institutional biases in schools, including the construction and delivery of careers advice, funnel students from different backgrounds toward certain education and career pathways?**

There is a general bias towards university study as a post-school destination. Some researchers call this the "well-lit" pathway.

Structures such as the school timetable underpin this bias by constraining the ways in which students can choose combinations of subjects as a programme of study. The advice from teachers, given to students as they make their choices within these timetable constraints, also tends to keep the academic pathway well lit, at least for students considered capable of university study by their teachers and schools.

Pathways to work or vocational learning are less esteemed and are typically promoted to students considered to be less academically able. This creates problems when assumptions are mismatched with actual demands. Examples include the agribusiness and engineering sectors. Both need highly qualified workers *and* those who can undertake work that does not need a university degree.

Careers education tends to privilege short-term information-giving over a career development focus. The latter would emphasise lifelong learning and the development of career management competencies as a response to the rapidly changing nature of work.

**In what ways do policy and regulatory settings limit flexibility in the schooling system and student choices?**

The schooling system is very flexible in theory. School-exit qualifications (National Certificates of Educational Achievement or NCEA) are designed as a modular system. Assessment in any NZQA-accredited school subject can contribute credits towards an NCEA award—there is said to be "parity of esteem" for many different types of achievements. In practice, the regulations for gaining University Entrance act to constrain Year 13 choices for students on the pathway to university.

NCEA's flexibility is a two-edged sword. There is clear evidence that UE regulations close down the university pathway for students who are not aware of the consequences of choosing more eclectic combinations of subjects, or of being encouraged to study "alternative" variants that lower the academic demands of certain subjects, especially mathematics. Such students may not be well advised by their schools. Greater proportions of students from low-decile schools are likely to encounter these risks, as are students from Māori or Pacific Islands backgrounds. A clear theme in the international and local literature is that family/whānau may also lack familiarity with certain types of careers and thus may also be unaware of the consequences of making poor choices of subject combinations.

**Is keeping options open until the end of secondary school a good strategy to prepare for an uncertain and rapidly changing future?**

The idea of keeping options open is not as clear-cut as it seems. It can be articulated by students who are uncertain about their futures and who don't yet know what future pathways they might commit to. They might say they are keeping their options open by choosing an eclectic mix of subjects that inadvertently narrows the pathways open to them (see above).

On the other hand, there is clear international evidence that continuing to study STEM subjects (sciences, technology, mathematics, and engineering) does keep options open—or at least keeps pathways into university study open. Yet students with an aptitude for these subjects may actually be thinking in terms of a narrow range of future options. In one research project, many Year 13 science-able students aspired to become doctors, vets, or dentists. They appeared to be unaware of a wider range of science-related fields of employment.

Another way of thinking about keeping options open is to ensure that every student has opportunities to develop their capabilities for learning, work, and life beyond school, regardless of the subjects they choose. Five "key competencies" are specified in the *New Zealand Curriculum* (*NZC*) for exactly this purpose. However, these are developed patchily in some subjects and schools, and are essentially ignored in others.

There are opportunity costs for keeping options open if expensive tertiary study does not lead to the type of work envisioned. Research in the UK has demonstrated the vulnerability of STEM careers to changing economic conditions. Some international and local researchers advise that the best strategy for coping in uncertain times is to choose according to personal interests and strengths rather than trying to second-guess financial returns from certain (well-lit) career pathways.

**Does the system architecture in New Zealand schools unnecessarily limit future choices for students?**

New Zealand's school system is underpinned by what researchers call an "education logic". The intention is that the system will be sufficiently flexible to meet the educational needs of every student, no matter how diverse these might be. Thus the system architecture should not, in theory, unnecessarily limit future choices. It can, however, do so in practice. Any system is as flexible or not as the thinking of those who enact it.

Timetable structures are a key part of the system architecture of secondary schools. There is considerable variability in their construction, particularly in how they divide up learning time through the school day. Even so, all schools need to juggle competing priorities to achieve the best on-balance allocation of teaching spaces and available staff. In consequence, their timetables are typically constructed along disciplinary lines that privilege the well-lit pathway. This structure constrains the ways students can combine subjects into overall study programmes. Vocational options in out-of-school settings (e.g., Trades Academies) challenge conventional timetabling assumptions and can be difficult to accommodate.

The qualifications system (specifically NCEA) and the national curriculum (*NZC*) are key components of the overall system. Both are designed to respond flexibly to the learning needs of every student. As already

outlined, there are fish-hooks to this flexibility, especially for students not travelling on the well-lit pathway to university.

**Does staying in school longer open more career/further study options? Does it close any options?**

There is no single way to answer this question. If students have post-school aspirations that require tertiary qualifications (especially university degrees) then, clearly, staying at school longer is important. One proviso is that subject *combinations* do actually keep further pathways open. They need to lead to both NCEA Level 3 and UE, and they must be cognisant of any prerequisites for higher-level study. Prerequisites are most likely to apply to mathematics and sciences courses. Their "vertical" knowledge structures assume certain foundational knowledge will have been built before more advanced levels are attempted.

Hypothetically, staying at school longer could close down opportunities such as undertaking an apprenticeship with an NCEA Level 2 prerequisite. In such cases, staying longer might mean missing out on a job with a good employer. It's not the staying that counts, but rather the alignment with aspirations.

**How much variability is there in the system between schools, and what drives variability?**

We did not find research that systematically quantifies between-school variability in the provisions made for subject choice. However, school decile is one clearly visible variable. There are indications that keeping pathways open can be more problematic for students in low-decile schools. The demographic composition of a school population reflects the socioeconomic status of the surrounding community, and the well-lit pathway might be a more familiar and comfortable fit for middle-class families whose children attend higher-decile schools. There are indications of cohort effects in the UK literature—who you go to school with can influence pathways choices.

This research has found one important indicator of *lack* of variability. Students' combinations of subjects tend to fall into a small number of *types of clusters*, regardless of the school they attend. This is likely to be an artefact of timetabling constraints (see above), and reflects assumptions about the sorts of subjects that are suitable for certain "types" of students. Presumptions about the abilities and potential of "academic" and "vocational" students appear to be deeply embedded in practice. Challenging this thinking is perhaps the greatest challenge—and opportunity—for opening up more flexible choice architectures. New types of courses, such as agribusiness, are a direct response to changing work trends and show what is possible.

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