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Graduate employability and the career thinking of university STEMM students

Bennett, Dawn, Knight, Elizabeth and Bell, Kenton

If graduates from STEMM—science, technology, engineering, mathematics and medical sciences—are to successfully navigate the labour market, they need diverse capabilities alongside self- and career awareness. The focus of this study was STEMM students’ perceptions of self, career and employability. The study asked over 2,000 commencing students to respond to an open question which asked how long they intended to work in their discipline. The findings lend weight to the use of social cognitive career theory, which emphasises that career- and study-related decision making are influenced by feedback and feed-forward mechanisms and by intra- and inter-personal, historical, and contemporaneous dimensions. The article ends with implications for higher education teachers, including the need for strategies with which to help a diverse student body create meaning from the career-related messages that abound in public discourse.

Keywords: graduate employability; career development; metacognition; teaching and learning; higher education; first year in higher education; Deleuze, first year students

Introduction

The forking paths into the future – the actual open future and all the rest – are the many alternative futures that would come about under various counterfactual suppositions about the present. The one actual, fixed past is the one past that would remain actual under this range of suppositions”. (Lewis 1986, 38, writing about the asymmetry of past and future.)

Time is a crucial concern for higher education; the pervasive global public discourse emphasises that many of the world's most in-demand occupations are relatively new and that the nature of people's work is changing rapidly. As a result, young people are increasingly exposed to messages such as the notion that they will experience an average of five different careers and 17 jobs across their working lives; that the careers they would like to pursue may not exist by the time they graduate; and that automation might negate the value of their skillsets in favour of a robotised solution (Foundation for Young Australians, 2017; World Economic Forum, 2016). The impact of this uncertainty on commencing higher education (HE) students' career thinking is unknown.

To explore how public discourse messages about the future of working life are reproduced and how career-related time is conceptualised by young people, the study reported in this article asked over 2,000 students who had just commenced their higher education studies how long they intended to work in their discipline. The students were studying one of the STEMM disciplines of science, technology, engineering, mathematics, and medicine/allied health. The decision to include students in medicine and allied health was informed by Grinis' (2016) finding that over one-third of STEM positions belong to non-STEM occupations and that one-sixth of the jobs advertised in non-STEM occupations are in fact STEM-related roles, signalling labour market agility across multiple related occupations.

The analysis considered how students expressed their future plans in relation to their present engagement and past decisions. From this analysis, we considered how the act of responding to questions about future plans might enable students to construct less linear meanings of their studies and future careers.

Context and background

Global trends in HE feature a massified market, diminishing public funding, a decoupling of

the labour market-HE relationship and an increase in neoliberalism. A feature of massification is a dramatic shift in the student population, including a decline in the late-teenage population and increases in students from all low socio-economic groups (Norton and Cherastidthan 2018). Multiple entry pathways together with changes in how, where and when students consume their studies, demand agile responses from all facets of higher education; they also demand renewed scrutiny of the social, educational and vocational value of HE studies.

Higher education students express a variety of concerns about their futures. Among these are that their degree might have limited value for their future employability (Rothwell, Jewell, and Hardie 2009). Donald, Ashleigh, and Baruch (2018, 513) agree that HE is increasingly viewed as an uncertain investment of time and money because of “increased tuition fees, associated student debt and interest payments eroding earning premiums”. Student anxiety also relates to uncertain futures and the rise of labour market precarity. Vocational-related anxiety has been reported in multiple discipline-based studies, including in medicine (Radcliffe and Lester 2003), social work (Dzieglelewski, Turnage, and Roest-Martl 2004), marine science (Geyde and Beaumont 2018) and the performing arts (Bennett and Bridgstock 2015).

Higdon (2018) and Higdon and Stevens (2017) join Bartlett and Tolmie (2017) in emphasising sectoral and disciplinary differences. These and other authors note that fields of study such as the arts, pure sciences and humanities feature work that is both precarious and fiercely competitive, and for which specialist graduate study is often a pre-requisite. News stories of intensifying social problems (e.g., housing costs, environmental degradation and conflict) serve to exacerbate students’ apprehension about the future.

The debated role of HE in developing graduate employability is heavily influenced by the above concerns. Whilst the sector has yet to reach a consensus on HE’s role in employability development, employers, taxpayers and governments alike are persistent in their calls for the

development of employability initiatives (Jameson et al. 2012; O’Leary 2019; Ramberg, Edgren, and Wahlgren 2019; Tran 2015; Tymon and Batistic 2016; Yorke and Knight 2007).

Despite these calls, the terms employment and employability are often conflated within the graduate outcomes rhetoric and within institutional employability initiatives. Whilst some attention has been paid to institutional definitions, approaches and marketing (Bennett et al. 2018; Holmes 2013; Knight 2019), the employability narrative has yet to distinguish between job-getting (employment) and the ability to create and sustain work over time (employability). This is a key concern because it is entirely possible “to be employable, yet unemployed or underemployed” (Wilton 2011, 87).

The data reported here arises from a project which defines employability not as the acquisition of skills or the attainment of a full-time job at the point of graduation, but as “the ability to find, create and sustain meaningful work across the career lifespan” (Bennett, 2018, p. i). This invokes constructions of time and troubles the purpose of higher education as providers of initial professional education. We hypothesized that a time-based orientation might go some way towards alleviating the conflation of employment and employability.

The perspective of time

The increasing number of university graduates has amplified employer expectations to the extent that a degree can be taken for granted by employers (Tymon 2013). Rather, students must differentiate themselves, and their future possible selves (Henderson, Stevenson, and Bathmaker 2019; Markus and Nurius 1986; Stevenson and Clegg 2011), from others in the labour market. In line with our definition of employability, this necessitates the development of a graduate identity for “what comes next”, not only at the point of graduation but also across the lifecourse (Jackson 2017; Smith et al. 2019; Smith, Hunter, and Sobolewska 2019).

Corresponding to the HE sector's interest in employability is an increase in studies of time (Shahjahan 2019), and many researchers are turning to classic theories to explore these contemporary issues. Robinson (2016, 2019), for example, built on Erikson's (1968) lifespan theory to suggest that the "quarter-life crisis" is increasingly exacerbated by concerns about employment instability. Similarly, Bamber, Allen-Collinson and McCormack (2017) applied van Gennep's (1960 [1909]) work on *rites of passage* and liminality or transitional states to conceptualize "occupational limbo" as a state distinct from both transitional and permanent liminality.

Time, as it is conceptualized across the lifecourse, presents a logical framework with which to understand the student experience. However, time itself is often an abstract, taken-for-granted constant (Bunn, Bennett, and Burke 2019), and this unthought temporality serves to reify hegemonic temporalities of capitalist-coloniality (Motta and Bermudez 2019). To address issues of both individual and sectoral difference, then, the unseen and unthought need to be unpacked through a lens of criticality. One such lens is Adam's (1990, 2004) conceptualisation of "timescapes", which can frame explorations of how conformity and institutional expectations of time might be a limiting or "other" influence on student outcomes. Another is Lent, Brown and Hackett's (1994) adaptation of SCT, social cognitive career theory (SCCT), which emphasises the need to bring into view both feedback and feed-forward mechanisms together with intra- and inter-personal, historical and contemporaneous dimensions of self and career. The student voice is central to these discussions.

The student perspective of employability

Surprisingly, recent research (e.g. Geyde and Beaumont 2018, Tymon 2013) suggests that the student perspective is often missing from discussions of employability. There is also limited evidence from cognitive or behavioural indicators to explain why some students are better than

others are at developing employability (Clements and Kamau 2018). Other scholars observe that it is difficult to ascertain whether, and in what instances, students' perceptions of their employability are accurate (Jackson and Wilton 2017; Monteiro, Ferreira, and Almeida 2018), or whether students have either a conceptual understanding of employability or the language with which to articulate it (Gedye and Beaumont 2018).

A student's study path and vision of possible selves or futures can foster both what Penttinen, Skaniakos and Lairio (2013) describe as a working life orientation and what Hodkinson and Sparkes (1997) describe as careership. These facilitate individuals' social construction of what a "meaningful" life might entail and also promote development of the self-belief and agency that underpin perceived employability (Turner 2014).

Theoretical framework and research question

The study reported here asked how commencing HE students frame time in relation to their studies and future work. The study adopted a social cognitive approach to learner development and careership, taking into account the social construction of career decision-making over time and applying this to career exploration and decision-making as posited by Lent et al. (2016).

We considered whether the act of responding to questions about future plans might bring to light possible selves, or "a multiplicity of open futures" (Williams 2011, 17). The temporal dimension represented a logical framework for our inquiry because of its ability to shift from representational thought, which locks identity into hierarchical categories and privileges being in the "here and now", towards a new way of thinking that promotes theories of "becoming" or futurity (Macarthur, Lochhead, and Shaw 2016).

Method

Instruments

The study employed a self-reflection tool, which comprises Bennett's (2018) employABILITY measure together with five open questions. The measure is grounded in social cognitive theory as above and incorporates career decision making, self-esteem, identity construction, citizenship, emotional intelligence, and graduate capabilities. Completion of the self-assessment tool generated a personalised profile report which included advice, sources of support and multiple embedded resources. The research question was explored through one of the tool's open questions, which asked: *How long do you think you will work in your major (discipline), once you graduate?*

Sample and ethical approvals

The tool was completed in class or as a required reading and completion took between 20 and 30 minutes. Ethical approvals were secured through the lead institution's Human Research Ethics Committee and student responses were anonymised prior to analysis. Although students were required to complete the self-reflection tool as part of their studies, they chose whether or not to include their responses in the dataset. Students also chose whether or not to respond to the open questions. Student quotations included in this article use pseudonyms.

The initial student dataset comprised of 3,859 student responses. Of this number, 2,704 responses were selected on the basis that the students were in the STEMM population, that is, they were undertaking major and/or minor studies in science, technology, engineering, mathematics or medical/health-related fields. The sample was further refined by eliminating respondents who had not answered the open question required for our analysis. The final dataset comprised 2,475 STEMM students, 93% of whom were full time students and 61% of whom were female; all students were enrolled at Australian universities. Respondents ranged in age from 16 to 61 years; the mean age was 21.5 years.

Analysis

Students were asked: “How long do you think you will work in your major (discipline), once you graduate? A total of 21,239 words were recorded in the students’ free text responses. The researchers manually coded the responses to extract the number of years and/or the key theme of each response. Where respondents gave a range of years, this was converted to the mid-point (for example, a response of 10-15 years was recorded as 12.5 years). A response such as “10 years plus” was coded as a given number (10 years plus was recorded as 10). In cases where students specified a number of years, responses were grouped in 5-year coding categories (i.e., 1-5 years, 6-10 years and so on). Synonyms were also grouped: for example, the manual coding revealed that both lifetime and retirement were common words. Readings of each complete case confirmed that these words could be coded together.

Shown at Table 1, analysis moved from basic coding of stemmed words through to the development of themes and conceptual categories, using the qualitative analysis software NVIVO. We first included stemmed words (e.g. hopefully, hoping, promising) as a single theme and excluded terminal and periphery words from the analysis. We then undertook stratified frequency analysis, visual mapping and cluster analysis. At times, data were represented as weighted word clouds to enable the team to visualise the data.

Table 1. Amalgamation of stemmed words into a single theme

Stemmed Words	Length	Count	Weighting (%)	Theme
age/s, day, year/s/yrs	5	908	8.45	Years
employable, employed, employer/s, employment, form/s, going, influence, make/s, making, process, run/ning, shaped, studies, study/ing, turns, work/s/ed, working, workplace	4	614	5.07	work
long	4	429	4.04	long
animal, life, lifetime, live/d/s, living	4	403	3.74	life

aspirations, aspire, bright, desire, hope/fully, hoping, promising, trusted	9	392	3.63	hope
retire/d/ment, retiring	6	384	3.61	retire
disciplinary, discipline/s, field/s, studies, study/ing, subject, training	10	266	1.64	discipline
balance, remain/s/der/ing, rest, stay/ing, stays	4	243	1.93	rest
acquired, aim/ing, become/s/ing, begin, beginning, captured, catches, come/s, develop/ed/ing, drive, experience/s, father, generation, get/ting, going, grow/ing, let, make/s, making, mother, start/ing, stick, sustainability, sustainable, take/s, taking	3	219	0.74	get
calling, calls, career/s	6	216	2.02	career
maybe, open, perhaps, possibilities, possible/ly, potential/ly	8	178	1.56	possible
care, like/d/s, liking, potential/ly, probably, similar, wish/ing	4	168	1.25	like
chance/s, determined, determiner, discoveries, feel/s/ing, find, get/ting, happen/s/ing, obtain, see/ing	4	164	0.99	find
believe/s, consider/ing, guess, imagine, intend, reason, reckon, suppose, think/ing, thought	5	164	1.11	think
major/s, majority	5	156	1.47	major

We next created nodes by exploring each word individually using an NVIVO framework matrix view of the data. Coding items were generated through cluster analysis which grouped together similar words, meanings and attribute values. This manual process enabled us to keep track of each word within its contextual sentence. Iterative coding produced a number of time-related word codes including aspiration, career-long engagement and predicted career change.

The coding process provided a heuristic with which to explore how students imagined time in relation to their studies. We acknowledge that coding has been criticized for the potential to lose the context of what has been said or to fragment the data and lose the narrative flow (Coffey and Atkinson 1996). To avoid these issues, we moved back and forth between the code book and the complete student response to the employABILITY tool, checking that the meaning and intent of each response to the time question was correctly understood (Alvesson and Sköldbberg 2009). Students' responses to the question of how they had selected their major were particularly pertinent and we cite some responses to this question within the article.

Findings and discussion

Imagining a future in STEMM

Students were asked how long they thought they would work in their discipline. Shown in Figure 1, 859 (34%) of students responded with a number of years. Responses varied from 0 years to over 30 years, with the latter sometimes expressed as career-long engagement.

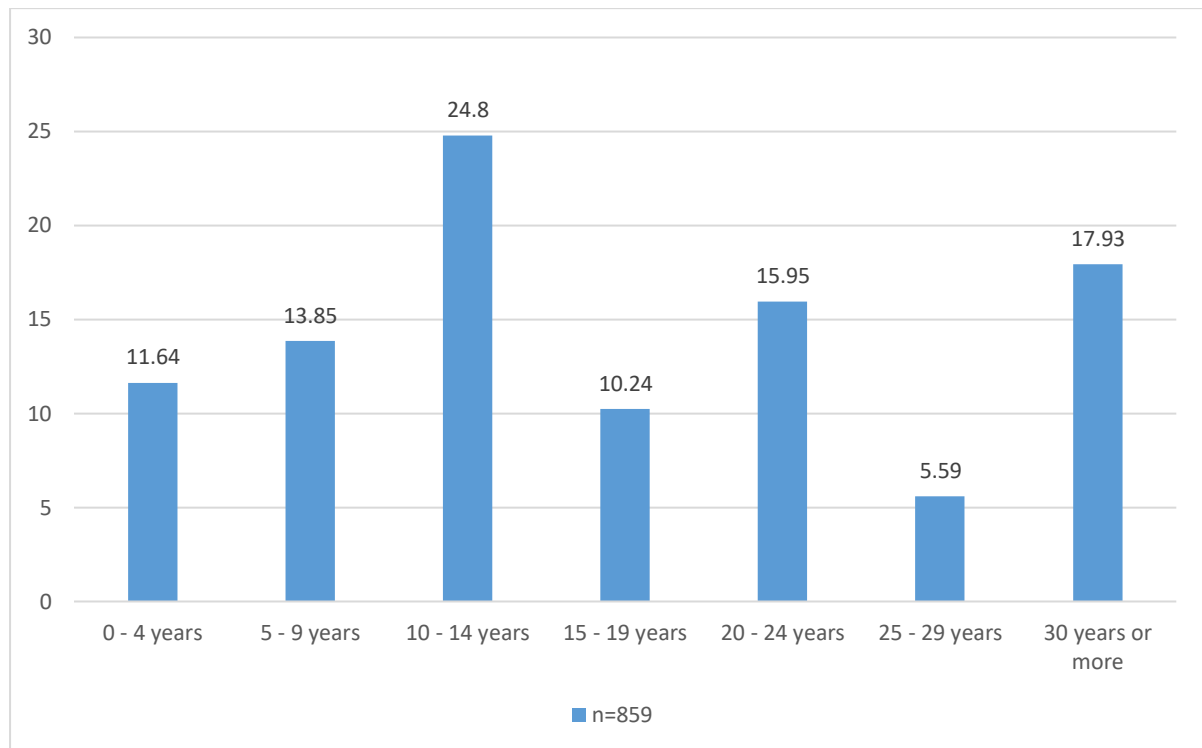


Figure 1. Years for which STEMM students expected to work in their discipline (%)

Theories of career decision are often underpinned by an assumption of predictability. This was not seen in the responses; rather, students were aware of potential challenges and the influence of changing personal circumstances. That career decisions are made and re-made on the basis of socially created identity and lived experience is an important point here because many higher education students have limited lived experience. As Hodkinson and Sparkes (1997, p. 35) point out, “no-one considers the whole range of possible opportunities in education or the labour market”; opportunities can only be considered if they can be “seen” or imagined: if they

lie within one's career horizons. Put simply, only the things people can see or imagine as being possible can become a goal; once these are ideated, they can theoretically be achieved.

Seen at Figure 1, the most common response to the question of how long students intended to work in their discipline was between 10 and 14 years. For most direct entry students, 10-14 years would represent the vast majority of their remembered life. It is crucial, therefore, that career development learning is inclusive of older labour market entrants and second careerists, such as the student cited below.

I will work in the discipline for the remainder of my life, given that I will be 50 years old when I graduate. (Mei, 1st-year female health sciences student)

The turning points (Strauss 1962) or epiphanies (Denzin 1989) associated with career decision-making are largely the result of periods of routine. Based on these routines, conceptualisations of career and identity—confirmed, contradicted and/or transformed over time—come together at the point of decision (Hodkinson and Sparkes 1997). In the case of HE students who enter their studies immediately or soon after completing high school (direct entry students), the routines on which career thinking might be challenged and expanded are severely limited. Students' (socially constructed) experiences had made visible their interest and passion for their discipline. However, some students masked discomfort or career concerns with humour and others simply wrote responses such as "I don't know". As seen in the following quotes, interest and humour were prevalent in the responses.

Since it is my passion, even a lifetime would not be enough. (Seth, 1st-year male engineering student)

Indefinitely, low estimate 200 years. (John, 1st-year male science student)

Until the cold grasp of death takes me. (Sacha, 2nd-year transgender nutrition student)

To help and assist in making a change in both a person and society. (Anne, 1st-year female health science student)

I want to help people, and use chemistry in my work. (Lee, 1st-year chemistry student)

Table 2. Time-related category codes (n=1,616)

Theme	Example/s	Count	%
Career-long	Lifetime / to retirement	1,007	62.3
Not known	No idea / Don't know	176	10.9
Aspiration	As long as I can	172	10.6
Long period, not determined	A long time	131	8.1
Emotion	As long as I enjoy it	74	4.6
Predicting a career change	About to change direction or foreseeing it	38	2.4
Specific rationale	Until I complete a specific challenge	18	1.1

Imaging a future beyond STEMM

Some students shared specific, personally utilitarian career goals. Several students, for example, wrote of personal circumstances such as starting a family. Other students planned to pursue their initial career only until they achieved a specific career or financial goal; after this, they planned to reassess their options.

Until I have successfully made a name for myself in the field and have made a design that betters the world. (Ash, 1st-year male architecture student)

To repay my (university) fees, then go from there. (Gavin, 1st-year male health studies student)

Likely until I retire or at least until I pay off my student loans and start really making money. (Rebecca, 1st-year female accounting student)

Until retirement or a new opportunity arises. (Rachel, 1st-year female speech pathology student)

It depends how much I enjoy it, and what happens with my family life. I plan to work in my major until I retire, but I cannot be certain as I am not 100% sure what the career and my life will entail. (Astghik, 1st-year female radiology student)

Understanding students' concerns

I think I will succeed in my field but am anxious about the future. (Nazim, 1st-year male public health student)

Responses such as an intention to work “for as long as I can” were sometimes encapsulated within students’ concerns about whether a career in STEMM was achievable and could be sustained over the longer term. Decisional anxiety is a legitimate concern for STEMM students given that there are fewer traditional jobs than graduates and given also the rate of technological change. Deming and Noray (2018, n. p), for example, find that information and communications technology (ICT) workers need to sustain the currency of their technology-specific skills from the date of graduation and that “the initially high economic return to applied STEM degrees declines by more than 50 percent in the first decade of working life” (Deming and Noray 2018, p.1)

A small number of students (2.4%) signalled a preparedness to transition to other work or careers should their STEMM work no longer be personally fulfilling. A reading of complete cases—students’ responses to all employABILITY questions within the tool—confirmed that none of these instances related to decisional self-efficacy or career confidence. Rather, students’ “openness” to diverse settings or other sectors of the economy related to their anxiety about creating and sustaining a career in STEMM over the longer term. An example follows.

It depends on my satisfaction and the ability to get a job. At least, if I don’t work in the same major, it will be one that I can transfer most of my skills across to. (David, 1st-year male ICT student)

Some student respondents noted that sustaining a STEMM career would also demand lifelong learning, as seen below.

Ideally, permanently in that field but with progression and further learning. (Jennifer, 1st-year female health studies student)

As long as I'm still qualified to practise it or a new software/robot makes me redundant. (Reika, 1st-year male Architecture student)

Labour market concerns might also account for the 10.9% of students who responded with comments such as “I don't know”. Seen in the examples below, some students were very negative about their graduate prospects. It is possible that these students are not sufficiently aware of the opportunities to apply their learning across multiple STEMM and non-STEMM industries. In these cases, low ability-related beliefs and limited career preview are likely to impede motivation and increase decisional anxiety.

Final author draft

There are no jobs in my major. (Ian, 1st-year male science student)

I think you over-emphasise personal abilities over external circumstances. I know from experience that my opportunities are very limited. (Jill, 1st-year female nursing student)

Students are inevitably exposed to the dominant discourses about employment and the future of work. As these discourses orient HE students toward competitive achievement and employability in a ‘future time’ (Clegg 2010; Horstmanshof and Zimitat 2007), the normalization of future-orientated temporalities is increasingly challenged. Gibbs’ (2015) study on the impact of concentrated skill development for the future world of work confirms that this approach fosters anxiety and discontent among students. We suggest that this is likely to be further emphasised among students whose limited life experience impedes their ability to make informed, domain-specific career decisions or to develop their career decision self-

efficacy, lending further support for the inclusion of career exploration and development within HE programs.

Concluding comments

The study reported in this article sought to explore how public discourse messages about the future of working life are reproduced and how career-related time is conceptualised by HE students. Every study has limitations and we outline these here. The study sampled first-year STEM students enrolled at Australian universities, and it treated students as a homogenous group. Future research might seek to analyse student thinking according to STEM discipline. It would also be interesting to see how students' thinking changes over time by engaging students in each year of study or by generating a retrospectively longitudinal dataset. In line with SCCT, we reiterate that conceptions of time are different for young people than for people with more years of lived experience. Although HE is often the focus of discussion about employability or future pathways, there is a need to expand on extant research such as that of Lyon and Carabelli (2015), Carabelli and Lyon (2016) and Reid, Rowley and Bennett (2019) to better understand how students develop future orientations long before caps and grown or *testamurs* signify the transition from expert student to novice professional.

We end with practical implications for teaching in higher education. The findings highlight students' anticipated career engagement within their disciplines and the rationale for these projections. Given the often-negative public discourses, it is compelling that almost half the cohort intended to work within their discipline for their lifetime. Some students were negative about their graduate prospects, often referring to dominant discourses from which they had learned that careers are unstable. They also mentioned that new technologies might limit their opportunities and that graduate employment is fiercely competitive. Their commitment, however, signals opportunities to engage students in dialogue, industry experiences and the

practical application of their knowledge through which they might form broader previews of STEMM work and make more informed decisions about their potential engagement.

Students' interest and passion for their discipline aligned with a desire to create social change through their work. This indicates the potential to develop more targeted opportunity awareness within STEMM programs. One practical strategy would be to develop students' proficiency in conducting career information searches, leading to a greater understanding of the pathways open to STEMM graduates and various ways in which organizations can provide flexible work arrangements. There is an associated need to broaden STEMM career narratives so that students are exposed to potential career pathways in non-STEMM industries. Such actions would enable students to develop their decision-making self-efficacy, thereby fostering expression of their identity and position with society (Cuzzocrea and Mandich 2016).

The findings also highlight the need for understanding the impact of messages about uncertainty. In practical terms, teachers might help students to create meaning from the career-related messages that abound in public discourse. This requires explicit career conversations within the core curriculum, supported by careers practitioners but embedded within the discipline studies which interest students. With STEM and STEMM a priority for governments in multiple countries, teachers might also encourage students to explore within these acronyms and consider more nuanced careers information about pathways relating to their specific specialization.

Noted earlier, the student demographic has changed considerably over recent times. A common feature of discourses around graduate success is that of employment, and yet multiple scholars (e.g. Pitman, Roberts, Bennett, and Richardson 2019) observe that disadvantaged students can fail to realize the same employment benefits from higher education as their peers; this is influenced by a student's social class, gender, ethnicity and geographical location. Similarly, the way in which young people imagine and negotiate their future careers is largely

dependent on the characteristics of their background, academic achievement and social interactions (Hodkinson and Sparkes 1997). From a policy perspective, equity policy, which has focused largely on access to higher education, could pay far more attention to student success, graduate outcomes, and public policy objectives.

Given that education and work trajectories have changed considerably over time, students' thinking is impacted by both contemporary experiences and by the historical and locational context that have socialised them. As such, students' socially constructed career previews—often heavily influenced by older, significant others and other primary socializers—are likely to be out of sync with the nature of contemporary work: for example, outmoded assumptions of gendered roles within the workplace or changes to behavioural expectations between colleagues and to those with power and authority. It is crucial, therefore, that university recruitment, retention and career development initiatives are intersectional and inclusive of the diverse lived experience on which students' conceptions of past and future are constructed.

Discussed earlier, SCCT emphasises that career- and study-related exploration and decision making are influenced by previous, current and perceived future self-efficacy and motivation. Eccles (2009, p. 82) adds that “life-defining choices such as those linked course enrolments, college majors, and occupational choice are influenced by the value individuals attach to the various achievement-related options they believe are available to them”. The concept of time within SCCT supported our theorisation of how students understood their future plans in relation to their present engagement and past exploration. In line with the rapidity of labour market change, the findings bring to mind Deleuze's philosophy of time, expressed by Williams (2017, 17) as “a complex and experimental negotiation with many times and with the undoing of strict determination, of subjective grounds and of appeals to eternal values or laws”. We conclude that this way of thinking has great potential to enable students

to look beyond traditional career pathways towards the metacognitive approach needed to conceptualise and negotiate both their present studies and their future careers.

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