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Alan Reubenson

Curtin School of Allied Health, Curtin University, Perth

Leo Ng

Curtin School of Allied Health, Curtin University, Perth

Department of Allied Health, School of Health Sciences, Swinburne University of
Technology, Melbourne

Daniel F Gucciardi

Curtin School of Allied Health, Curtin University, Perth

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Demographic and academic determinants of final year physiotherapy clinical placement performance trajectories and consistency

Alan Reubenson*, Leo Ng^{◇,*}, Daniel Gucciardi *

* Curtin School of Allied Health, Curtin University, Perth

◇ Department of Allied Health, School of Health Sciences, Swinburne University of Technology, Melbourne

Abstract

Objective: Little is known about key determinants of clinical placement performance among physiotherapy students. We assessed whether students' learning curves and performance consistency vary across final year placements and examined which person-level characteristics relate to average performance, learning trajectories, and consistency.

Methods: We sampled 561 undergraduate physiotherapy students from an Australian university who completed final year clinical placements between 2014 and 2017. We analysed archival demographic data and clinical educators' assessments collected across four, 5-week placements using the Assessment of Physiotherapy Practice (APP).

Results: Cognitive ability and language skills produced consistent effects across professional and clinical practice domains, whereas factors such as the country where students completed high school, age, gender, and the number of supplementary assessments taken during the first three years influenced performance in specific domains.

Conclusions: Certain demographic and academic factors represent a small but important piece of the puzzle regarding the growth and consistency in clinical performance. However, given the dynamic nature of clinical placement performance, other psychosocial and contextual factors likely play an important role for person-situation interactions within placement settings. Identifying the most important determinants of clinical performance will permit enhanced and targeted curricular development to maximize clinical placement success.

I INTRODUCTION

Clinical placements are integral to any physiotherapy curricula that produces entry-level physiotherapists upon completion (Australian Physiotherapy Council, 2025a). Clinical placements allow students to integrate theoretical knowledge and skills acquired in campus-based learning into authentic, real-world healthcare settings and provide opportunities for clinical educators to monitor and assess student performance over time across diverse settings (e.g., acute, community) (Ajjawi et al., 2020; Higgs, 2012; Patton et al., 2013). This transition from campus-based learning into real-world healthcare can be challenging. Students are exposed to new, dynamic, unpredictable workplace environments and patient encounters (e.g., diverse patient presentations, exposure to suffering, death and dying), as well as added pressure to perform competently to meet professional practice standards (Australian Physiotherapy Council, 2025b; Physiotherapy Board of Australia & Physiotherapy Board of New Zealand, 2023). Students experience varying degrees of stress and can struggle to cope with the challenges encountered, regardless of their previous academic achievements (Delany et al., 2015; Dyrbye et al., 2006; Gallasch et al., 2022; LeBlanc, 2009; Milgate et al., 2024; Tucker et al., 2006; Walsh et al., 2010). There is a need to understand why some students struggle, whereas others thrive in the face of multiple competing demands when completing clinical placements.

Emerging adulthood, the crucial period between late adolescence and early adulthood, is among the most critical life transitions because we experience numerous and diverse changes and challenges (Arnett, 2018). Within the context of tertiary studies, the transition from classroom-based learning into workplace-based learning represents one such example for physiotherapy students (Chipchase et al., 2012; Judd et al., 2023). Workplace environments in which clinical placement learning occurs are complex, multi-dimensional, and dynamic spaces that differ greatly from typical tertiary academic settings (Patton et al., 2013, 2018). Academic learning tends to be more structured and predictable, typically involving attendance and engagement in lectures, tutorials, and practical classes with discrete competencies evaluated through traditional, standardized assessments (e.g., written assignments/tests, objective structured clinical examinations [OSCEs], vivas). A key feature of academic learning is that it is student-centric (Cooper et al., 2010). In contrast, clinical placements occur in authentic, unpredictable healthcare and health promotion settings, where the priority is the provision and delivery of safe and effective care to the public, followed by student learning (McGivern et al., 2025). Over the duration of a clinical placement, which is typically 4–6 weeks in pre-registration physiotherapy courses, physiotherapy students work individually and in interprofessional teams, under the supervision of qualified healthcare professionals, providing care to a diverse range of clients and clinical presentations. Each clinical placement offers students graduated opportunities to integrate existing and new knowledge and skills into new professional practice settings. Placements allow students to receive and respond to feedback and develop the necessary entry-level clinical performance competencies required for registration as a physiotherapist. Collectively, clinical placements are integral components of all physiotherapy degrees designed to produce graduates who are autonomous, first contact practitioners, with skills and abilities to be safe, ethically- and culturally-effective, evidence-based, reflective practitioners and lifelong learners (Australian Physiotherapy Council, 2025b; Lawton et al., 2023; Stoikov et al., 2022; Wells et al., 2021; World Physiotherapy, 2021, 2023a, 2023b).

Conceptualizing the transition from campus-based learning to the clinical placement setting as purely a translation of theory into practice ignores the salient and complex physical (e.g., learning resources available), socio-cultural (e.g., supervisor motivations and dispositions, workplace culture), and temporal (e.g., availability of time for reflection and consolidating learning) dimensions that can inhibit or facilitate learning (Kurunsaaari et al., 2022; Nisbet et al., 2021; Patton et al., 2013, 2018). Numerous learning theories, encompassing these dimensions, have been proposed to conceptualize and enhance workplace learning (Patton et al., 2013). Situated (Lave & Wenger, 1991) and workplace (Billett, 1992, 2001, 2004, 2006, 2008, 2009a, 2024) learning theories highlight how workplace learning unfolds and is systematically constructed through active

and graduated participation in professional practice activities and communities of practice. The workplace environment and affordances available, and how students interact with these key elements of the learning process, influence individual learning outcomes and trajectories. Social learning theories (Rogoff, 1990; Vygotsky, 1978) emphasize social and professional relationships in clinical placement learning. Particularly salient is the role of clinical supervisors in establishing a productive student–supervisor relationship; providing a safe, supportive learning environment that assists students to integrate into the workplace culture and communities of practice; and guiding and scaffolding student learning (Clouder & Adefila, 2017; Clouder et al., 2022; Milgate et al., 2024; Schmutz et al., 2021; Sellberg et al., 2022). Learning with and from patients, colleagues, peers, caregivers, and other healthcare and support staff is also important (Delany & Bragge, 2009; Lindquist et al., 2006; Lindquist et al., 2010; Nisbet et al., 2021; Nisbet et al., 2023; Patton et al., 2018; Solvang & Fougner, 2023). Finally, consideration of learner attributes (e.g., knowledge, skills, abilities) and dispositions (e.g., assertiveness, motivation) alongside temporal interactions with the physical and socio-cultural environment, highlights the unique and individual factors, within and external to the placement, that affect student performance in clinical placement settings (Billett, 2009b; Lindquist et al., 2006; Lindquist et al., 2010; Milgate et al., 2024; Patton et al., 2018; Ployhart et al., 2014; Schrewe et al., 2018; Smith et al., 2023).

Hosting clinical placements and having students involved in healthcare delivery provides benefits to students, patients, supervisors, health service organisations and universities (Bourne et al., 2019; Bowles et al., 2014; McBride et al., 2020; McBride et al., 2015; Nisbet et al., 2023; Smith et al., 2023). Anecdotally, according to Clinical Education Managers of Australia and New Zealand (CEMANZ), most physiotherapy students navigate clinical placements successfully, with only a small percentage (~ <5%) of students failing placements (see also Lawton et al., 2021). However, success and failure rates often ignore students who require additional resources and support to reach a passing standard (Bell et al., 2024; Foo et al., 2017; So et al., 2019). When students struggle on clinical placements, negative effects are borne by the student, their social supports, peers, the placement hosting organisation, clinical supervisors, and university staff. There are academic (e.g., delayed course progression), financial (e.g., cost of repeating the placement), health (e.g., reduced physical and mental wellbeing), behavioural (e.g., reduced motivation), and emotional (e.g., low self-esteem, embarrassment, anger) consequences for the student (Foo et al., 2017; Milgate et al., 2024). Supervisors managing underperformance have reported heightened level of stress and guilt, increased workloads, lowered self-confidence, and reduced willingness to host student placements in the future (Smith et al., 2023; So et al., 2019). Similarly, additional time and resources are needed by university staff to provide support to students and placement hosts (Bowles et al., 2014; Foo et al., 2017; Milgate et al., 2024; Smith et al., 2023). Universities would like students to be well prepared to meet the demands and expectations of clinical placements (Judd et al., 2023). Knowledge of which students are at increased risk of struggling is essential for early and targeted support and remediation.

Research on the determinants of clinical performance in entry-level physiotherapy is in its infancy, relative to knowledge on academic performance (Ball et al., 2024; Chisholm-Burns et al., 2021; Fong et al., 2021; Reynolds et al., 2021; Richardson et al., 2012). Successful completion of clinical placements requires competence in areas that span cognitive (e.g., understanding of concepts), physical (e.g., manual therapy techniques), and social (e.g., communication) skills. Students must make high-level clinical reasoning decisions, integrating theory and skills into practice in a safe and ethical manner (Higgs et al., 2008). Prior work has identified several applicant and student attributes associated with clinical performance, typically reporting bivariate correlations (r) and, in some cases, model-level variance explained (adjusted R^2). To date, pre-admission interviews (e.g., $r = 0.322$; Edgar et al., 2014; adj $R^2 = 0.04 - 0.09$; Paynter et al., 2022), student reflective ability ($r = 0.411$; Brooks et al., 2017), self-efficacy (Reynolds et al., 2021), behavioural styles (Milne et al., 2019), and grit ($r = 0.22$; Calo et al., 2022) have been identified as meaningful determinants of clinical performance. In contrast, there exist mixed results for factors like practical examinations (Terry et al., 2017, 2020), performance on simulation (Judd et al., 2018; Ryall et al., 2022), student demographics (Edgar et al., 2014; Lewis, 2010), pre-admission

grades/test results (Edgar et al., 2014; Lewis, 2010, 2011; Paynter et al., 2022), course GPA (Edgar et al., 2014; Lewis, 2011), and emotional intelligence (Lewis, 2010, 2011).

Knowledge of key determinants of physiotherapy clinical performance could inform targeted interventions across multiple, intersecting personal and social ecologies to maximize student success in clinical practice. In this study, we leveraged historical data to examine determinants of entry-level clinical performance in two ways. First, we examined multiple determinants simultaneously rather than one or two in isolation (Brooks et al., 2017; Terry et al., 2020) to estimate the relative importance across several potentially important factors. Knowledge of the relative importance of individual determinants among a network of multiple factors is required for the prioritisation of intervention targets for proactive efforts to optimize clinical performance. Second, we statistically modelled multiple assessments of clinical performance for each student to maximize synergies between concept and operationalisation. Relying on a single snapshot of clinical performance is incongruent with how most tertiary institutions make inferences regarding students' readiness to enter the workforce. Rather, students' clinical performance is assessed across multiple placements that vary in their substantive focus (e.g., musculoskeletal, neurological) and contextual setting (e.g., acute, rehabilitation). Doing so means that we can estimate the relative importance of determinants on students' overall performance and learning trajectories across multiple performance assessments (mean levels), as well as the consistency with which they perform across diverse settings and contexts (intra-individual variability). Ultimately, we want graduates who perform consistently at a high standard across time and context regarding the quality of their healthcare (e.g., safety, interpersonal dynamics).

Against this backdrop, we examined physiotherapy students' clinical performance longitudinally across a series of final year placements and estimated the relative importance of demographic and academic factors for their learning curves and consistency in performance. The specific research questions were:

- To what extent do physiotherapy students vary regarding their (i) learning curve and (ii) consistency in clinical performance across their final year placements?
- What person-level characteristics contribute meaningfully to understanding physiotherapy students' (i) average performance, (ii) learning curves and (iii) consistency in clinical performance across their final year placements?

II METHODS

A Design

We accessed archival student demographic and clinical educators' assessment data of student clinical placement performance across four, 5-week, final year clinical placements. The clinical placements span across placement types (e.g., musculoskeletal, neurological, cardiopulmonary and/or combinations of these), settings (e.g., acute care, rehabilitation and community), and the human lifespan (e.g., paediatrics through to gerontology). These data were utilized in a previous study focused solely on the psychometrics of the primary outcome measure (Reubenson et al., 2020). Our University Human Research Ethics Committee approved the study (HRE2017-0568) and provided approval for consent waiver.

B Participants

Undergraduate physiotherapy students from one Australian university, enrolled to complete their final year clinical placements between 2014–2017, participated. We excluded students who only completed one final year placement before exiting the course, given our focus on learning trajectories and variability in performance.

C Primary outcome

The Assessment of Physiotherapy Practice (APP) is a 20-item informant-reported tool that captures one's proficiency in seven domains of clinical practice, including professional behaviour, communication, assessment, analysis and planning, intervention, evidence-based practice, and risk management. Clinical supervisors assessed students' performance on each placement block using a 5-point scale ranging from 0 (seldom meets criteria) to 4 (excellent performance). Full details of the APP can be found in the original development and initial validation work (Dalton et al., 2011, 2012). Aligned with recent psychometric evidence (Reubenson et al., 2020; Reubenson, Ng, et al., 2025), we operationalized clinical performance as the average score of items according to two dimensions – professional (items 1–4) and clinical (items 5–20).

A minimum of four (out of five) final year clinical placements are assessed using the APP at our institution. For each placement, clinical educators assess students based on their performance across a 5-week period, and against entry-level competencies aligned with the Australian and New Zealand physiotherapy standards (Australian Physiotherapy Council, 2025b; Physiotherapy Board of Australia & Physiotherapy Board of New Zealand, 2023). We categorized placements into one of four placement types: cardiopulmonary; musculoskeletal; neurological; and other (miscellaneous category such as aged care, paediatrics).

D Determinants of clinical performance

We retrieved several demographic indicators of students (age, gender, Year 12 country, main language) as well as their academic performances (course progression, honours, course weighted average, total fails, total supplementary assessments) from university databases (see Table 1).¹

¹ We also had access to Australian Tertiary Admission Rank (ATAR) scores for approximately 85% ($n = 479$) of the sample who completed secondary education in Australia. The ATAR reflects a student's overall performance in the final year of their high school, where scores can range from 0 to 99.95 to indicate an individual's performance relative to all other students in their cohort for that year. An ATAR of 90, for example, indicates a student who scored in the top 10% of their cohort. Entry into physiotherapy programs at our participating institution is generally in the ATAR 90s and there is little variation in ATAR scores ($M = 92.7$, $SD = 4.8$). Substantively, ATAR can be considered proxy for general cognitive ability upon completion of secondary school. We prioritized course weighted average of the physiotherapy undergraduate program in our analyses because it provides a proxy of cognitive ability that is specific to physiotherapy clinical performance, and meant that we retained all students in the final analysis; utilising ATAR would result in substantial loss of data in the final model (~15%). We also prioritized Year 12 country as a determinant in our statistical model rather than citizenship. Given the substantial overlap between these two variables, the inclusion of citizenship in the statistical model introduced suppression effects.

Table 1: Study variables and demographic information of participants

Characteristic	Participants (n=561)	Description of Characteristic
Age (y), mean (SD)	22.95 (3.55)	Participant age at the start of final year
Gender, n (%)		Female or male. Our university captures this data on entry to the course — we acknowledge that students might identify in ways that differ from these two categories
Female	378 (67)	
Male	183 (33)	
Citizenship, n (%)		Australian or International
Australian	490 (87.3)	
International	71 (12.7)	
Year 12 country, n (%)		Country where student completed secondary schooling
Australia	451 (80.4)	
International	110 (19.6)	
Main language, n (%)		English or Other
English	513 (91.4)	
Other	48 (8.6)	
Course Progression, n (%)		Typical course progression was assigned to students that completed the first 2 years (for students who started the course in second year) or 3 years (for students who started the course in first year) of the course consecutively. Atypical course progression was assigned to any student that took longer to complete the first 2 or 3 years of the course due to having failed subjects and needing to repeat units or taking time away from the course for other reasons (e.g., illness, family matters)
Typical	422 (75)	
Atypical	139 (25)	
Course Entry Score		ATAR = a number between zero and 99.95 ranking Year 12 secondary school performance within a year group (only applicable for participants that completed secondary school in Australia)
Australian Tertiary Admission Rank (ATAR), mean (SD) / n (%)	92.7 (4.8) / 479 (85.4)	
Alternative course entry or Tertiary Entrance Rank unavailable, n (%)	82 (14.6)	
Honours, n (%)		Students apply to join the 2-year Honours program (across the final 2 years of the course)
Yes	50 (8.9)	
No	511 (91.1)	
Course Weighted Average (CWA) at end of course, mean (SD)	71.58 (4.8)	This study used the CWA at the end of the course (based on approximately 36 units / 800 credits) with a

		range of one to three of these (25–75 credits) taking place in final year. Although this value included up to 3 coursework units in final year, it would still represent an indicative CWA (91–97% up to end of third year) for students prior to completing final year placements and acts as a proxy for academic achievement prior to completing final year clinical placements
Total Failed Assessments, n (%)		Total number of years of the 3 years prior to final year where students failed one or more units (would only apply to students assigned to the atypical course progression category). Coded as 0–3
Fails in 1 st year	43 (7.66)	
Fails in 2 nd year	44 (7.84)	
Fails in 3 rd year	50 (8.91)	
Students with fails in all 3 years	4 (0.7)	
Students with fails in 2 years	18 (3.2)	
Students with fails in 1 year	89 (15.9)	
Students with no fails in first 3 years	450 (80.2)	
Total Supplementary Assessments, n (%)		Total number of years of the 3 years prior to final year where students were granted supplementary assessments at the end of a study period, regardless of whether these were successful or not. Coded as 0–3
Supplementary assessments in 1 st year	136 (24.24)	
Supplementary assessments in 2 nd year	234 (41.71)	
Supplementary assessments in 3 rd year	302 (53.83)	
Students with Supplementary assessments in all 3 years	60 (10.7)	
Students with Supplementary assessments in 2 years	167 (29.8)	
Students with Supplementary assessments in 1 year	158 (28.2)	
Students with no Supplementary assessments in first 3 years	176 (31.4)	
Placement Type, n (%)		Categorisation of placements undertaken
Cardiopulmonary	565 (25.3), fails = 26 (4.6%)	
Musculoskeletal	557 (24.9), fails = 14 (2.51%)	
Neurological	554 (24.8), fails = 24 (4.33%)	
Other	560 (25.0), fails = 25 (4.46%)	

E Data analysis

We examined the research questions using location-scale models (McNeish, 2021) within a multilevel structural equation modelling framework in *Mplus* 8.10 (Muthén & Muthén, 2017), whereby clinical placement scores (Level 1) are nested within students (Level 2). Students could differ in their overall average (random intercepts), linear learning curve (random slopes), and degree of stability in clinical performance across multiple placements (heterogeneous variances). We utilized Bayesian estimation with Markov chain Monte Carlo (MCMC) methods for computational convenience rather than the motivating philosophy (Levy & McNeish, 2023). The estimation relied on default non-informative priors across four chains each with at least 50,000 iterations, ensuring that data drove the characterisation of the posterior distribution. The Gibbs sampler treats missing data as unknown values, which are estimated under the ‘missing at random’ assumption and utilized in combination with observed data and priors to characterize the posterior distribution (Asparouhov & Muthén, 2010). We relied on the 95% credibility interval — the range of values where the true value most likely resides — to express uncertainty and therefore infer the statistical meaningfulness or ‘credibility’ of effects. *Mplus* syntax scripts and outputs are available on the Open Science Framework (<https://bit.ly/3MWCwgz>).

III RESULTS

A Flow of participants

In total, 564 students were enrolled in final year clinical placement units between 2014 and 2017. Three students were ineligible by virtue of completing less than two final year placements. Of the 561 retained students, 542 were assessed on four placements, 14 were assessed on three placements, and five were assessed on two placements. Baseline demographic information is provided in Table 1.

B Characterisation of learning curves and consistency in clinical performance

In unconditional models excluding determinants, we found students performed well, on average, across their clinical placements on both professional ($\gamma = 3.22$, [95% CI = 3.18, 3.27]) and clinical ($\gamma = 2.75$, [95% CI = 2.70, 2.79]) dimensions. Regarding learning curves, students’ performance improved across each placement in both professional ($b = .06$, [95% CI = .04, .08]) and clinical ($b = .05$, [95% CI = .04, .07]) dimensions. Estimates of intra-individual variability indicated that students differed from one another in their stability in both professional ($\omega_{\logscale} = -1.36$ [95% CI = -1.45, -1.28]) and clinical ($\omega_{\logscale} = -1.46$ [95% CI = -1.55, -1.39]) performance dimensions across multiple placements. Exponentiated to the original scale, the expected residual variance is $\sigma_j^2 = .26$ [95% CI = .24, .28] for the professional dimension and $\sigma_j^2 = .23$ [95% CI = .21, .25] for the clinical dimension, on average. Students who performed better overall demonstrated less variability (clinical = $-.08$ [-0.11, -0.05], professional = $-.15$ [-0.20, -0.1]) and less improvement (clinical = $-.004$ [-0.01, .01], professional = $-.01$ [-0.02, -0.001]) in their performance.

C Determinants of learning curves and consistency in clinical performance

Full results of these analyses are presented in Table 2 and Figure 1. Regarding the clinical dimension of performance, students who obtained higher course weighted averages performed best overall ($b = .03$, [95% CI = .01, .04]), whereas students for whom English is a second language performed worse than individuals whose primary language is English ($b = -.26$, [95% CI = -.41, -.11]). Students who completed their high school education overseas rather than in Australia ($b = .34$, [95% CI = .12, .59]) and older students ($b = .03$, [95% CI =

.02,.06]) evidenced the greatest performance variability across their placement series, whereas female students, relative to male students, evidenced less performance variability ($b = -.15, [95\% CI = -.29, -.01]$).

For the professional dimension of performance, students who received a higher number of supplementary assessments across the first 3 years of their coursework performed worse overall ($b = -.09, [95\% CI = -.15, -.03]$) yet evidenced the greatest improvements across the placement series ($b = .03, [95\% CI = .002, .06]$). Students for whom English is a second language performed worse overall ($b = -.24, [95\% CI = -.40, -.08]$). Students who obtained higher course weighted averages performed the best overall ($b = .02, [95\% CI = .003, .03]$) and varied less across the placement series ($b = -.03, [95\% CI = -.06, -.001]$).

Table 2: Unstandardized estimates and credibility intervals of determinants of learning curves and consistency in clinical performance

Clinical Performance					Professional Performance				
	Predictor	Estimate	95% CI			Predictor	Estimate	95% CI	
Intercepts	Overall average	2.77	2.57	2.97	Intercepts	Overall average	3.25	3.04	3.45
	Linear Change	.08	-.02	.17		Linear Change	.04	-.06	.14
	IIV (log scale)	-1.52	-1.85	-1.17		IIV (log scale)	-1.21	-1.58	-.80
Linear Change ←	Age	-.01	-.01	.00	Linear Change ←	Age	.00	-.01	.00
	Gender	-.01	-.05	.04		Gender	.00	-.04	.04
	CWA	.00	-.01	.01		CWA	.00	-.01	.01
	Language	.04	-.03	.11		Language	.06	-.02	.14
	Year 12 Country	-.07	-.14	.00		Year 12 Country	-.07	-.13	.002
	Progress	.00	-.07	.08		Progress	.02	-.07	.09
	Honours	.03	-.04	.10		Honours	.00	-.06	.07
	Fails (total)	-.01	-.07	.06		Fails (total)	-.03	-.10	.04
	Supplementary assessments (total)	.01	-.02	.03		Supplementary assessments (total)	.03	.002	.06
IIV ←	Age	.03	.02	.06	IIV ←	Age	.02	.00	.04
	Gender	-.15	-.29	-.01		Gender	-.18	-.35	.01
	CWA	-.02	-.04	.01		CWA	-.03	-.06	.001
	Language	.02	-.22	.30		Language	.17	-.17	.46
	Year 12 Country	.34	.12	.59		Year 12 Country	.19	-.07	.48
	Progress	-.13	-.42	.13		Progress	-.20	-.51	.09
	Honours	-.03	-.30	.27		Honours	-.12	-.45	.19
	Fails (total)	-.04	-.27	.19		Fails (total)	.02	-.23	.27
Overall Average ←	Supplementary assessments (total)	.01	-.10	.11	Overall Average ←	Supplementary assessments (total)	-.03	-.14	.09
	Age	.00	-.01	.01		Age	.01	-.01	.02
	Gender	.05	-.04	.14		Gender	.08	-.01	.17
	CWA	.03	.01	.04		CWA	.02	.003	.03
	Language	-.26	-.41	-.11		Language	-.24	-.40	-.08
	Year 12 Country	-.03	-.18	.12		Year 12 Country	.07	-.08	.21
	Progress	-.01	-.17	.15		Progress	.00	-.17	.17
	Honours	.03	-.12	.17		Honours	.03	-.12	.17
	Fails (total)	.05	-.09	.18		Fails (total)	.07	-.08	.22
	Supplementary assessments (total)	-.04	-.10	.01		Supplementary assessments (total)	-.09	-.15	-.03

Fixed Effects	Overall Average ↔ Linear Change	.00	-.01	.01	Fixed Effects	Overall Average ↔ Linear Change	-.01	-.02	.00
	Overall Average ↔ IIV	-.05	-.08	-.02		Overall Average ↔ IIV	-.11	-.15	-.08
	Linear Change ↔ IIV	.00	-.01	.01		Linear Change ↔ IIV	.00	-.01	.01
Random Effects	Overall Average ↔ Linear Change	-.22	-.66	.45	Random Effects	Overall Average ↔ Linear Change	-.47	-.89	.03
	Overall Average ↔ IIV	-.83	-1.00	-.49		Overall Average ↔ IIV	-.93	-1.00	-.81
	Linear Change ↔ IIV	-.19	-.76	.44		Linear Change ↔ IIV	.12	-.40	.71
Residual Variances	Overall Average	.06	.04	.09	Residual Variances	Overall Average	.07	.05	.10
	Linear Change	.00	.00	.01		Linear Change	.00	.00	.01
	IIV	.06	.02	.10		IIV	.22	.12	.32
Variance Explained	Overall Average	.18	.09	.29	Variance Explained	Overall Average	.17	.09	.27
	Linear Change	.28	.05	.66		Linear Change	.40	.10	.82
	IIV	.34	.16	.56		IIV	.13	.05	.27

Note: IIV = intra-individual variability; CWA = course weighted average.

IV DISCUSSION

Utilizing archival data at an Australian university, we found that final year physiotherapy students typically demonstrated meaningful improvement in both professional and clinical dimensions of clinical performance across four final year placements. We also found that students differed in their degree of consistency across both dimensions of clinical performance across these four placement experiences. Regarding determinants of overall performance, linear changes, and variability estimates, our findings suggest that different factors influence clinical and professional performance in distinct ways. Intellectual skills and knowledge (e.g., analytical reasoning, problem-solving) pertinent to the content domain of entry-level physiotherapists and language evidenced reasonably consistent effects across both domains, whereas the country where students completed their high school studies, age, gender, and the number of supplementary assessments received during the first 3 years of their degree had domain-specific effects.

We found, on average, that students' performance on up to four, 5-week clinical placements in diverse practice settings, across approximately 12 months, generally improved over time in both professional and clinical dimensions. With cross-sectional snapshots of clinical performance, the *modus operandi* among existing work (Calo et al., 2022; Milne et al., 2019), our study is the first to provide empirical evidence of a learning or growth trajectory of clinical performance among undergraduate physiotherapy students. Practically, the observed improvement in performance across placements in both professional and clinical domains confirms that most students can effectively learn and apply their knowledge in a clinical setting. Conceptually, this learning trajectory aligns with developmental theories in which it is hypothesized that progression of competence over time occurs following the kind of repeated practice incorporated into clinical placements (Kurunsaari et al., 2022). Of course, there exist other qualitatively different learning trajectories, such as quadratic (e.g., U-shaped) and cubic (e.g., S shape) effects, that model non-linear changes in clinical performance (Govaerts & van der Vleuten, 2013) or related factors (e.g., empathy) (Bayliss & Strunk, 2015).

Students attending clinical placements need to adjust to novel environments each time they commence a new placement. Socioecological perspectives like the Process-Person-Context-Time (PPCT) model (Dickson & Darcy, 2021) offer holistic backdrops upon which to consider key determinants and development of professional competencies within diverse, complex, and unpredictable environments such as clinical placements. The 'Process' refers to regular interactions between the 'Person' (e.g., student) and their environment (e.g., interactions with patients and supervisors); 'Context' reflects the changing clinical placement settings (e.g., acute, community) and areas of practice (e.g., musculoskeletal, cardiopulmonary) encountered across the year; and 'Time' encompasses the temporal sequencing or longitudinal nature of interactions. Our study offers an initial first look at the interface among these elements via estimation of intra-individual variability alongside mean-level estimates of overall performance and linear change, as well as personal factors that might influence one's engagement with clinical processes and contexts across time. Regarding variability in clinical performance, its omission among existing research is important because it is well known that indices of functioning vary temporally and situationally (Dalal et al., 2020). We provide the first evidence to support the generalisation of this self-regulatory characteristic — that is, the capacity for individuals to modulate their behaviour in response to changing contextual demands — to clinical performance among undergraduate physiotherapy students. Intra-individual variability is to be expected, with individuals likely to experience different behavioural responses while transitioning into and during each new placement setting (Tigelaar & van der Vleuten, 2014), unless the 'transferability' element of skill and knowledge acquisition is explicitly addressed during training. Personal and contextual factors likely play important roles in intra-individual variability in clinical performance. Self-reported confidence, for example, tends to revert to baseline levels at the start of new practice areas, despite improvements experienced during previous immersive simulation placement blocks (Wright et al., 2018). Our multifaceted approach to operationalising clinical performance dynamics

provides the necessary resolution for identifying key determinants that could inform one-size-fits-all *and* personalized interventions for learning and development.

Owing largely to the archival nature of our data, we examined demographic and academic factors primarily as determinants of mean-levels and intra-individual variability in clinical performance. Broadly, our findings support the meaningfulness of factors that students bring with them to the university context (age, gender, language, country where they completed high school) and which reflect students' performance on discipline-specific theoretical knowledge and skills acquired via campus-based learning (course weighted average and number of supplementary assessments). In the context of our research setting, Course Weighted Average (CWA) can be conceived broadly as a domain-specific proxy of cognitive ability prior to completing clinical placements. Intuitively, one would anticipate that students with lower baseline knowledge and skills might encounter greater variability in clinical performance as they engage and interact with diverse patients and contextual settings. Cognitive ability is a well-known determinant of job performance (Van Iddekinge et al., 2018), particularly in scenarios that require people to adapt to dynamic contextual considerations (Stasielowicz, 2020). Our findings confirm this general expectation and extend knowledge to clinical performance settings among physiotherapy students, where strong academic foundations in discipline-specific content likely facilitate the acquisition, refinement, and application of knowledge and skills pertinent to patient care across diverse healthcare settings.

Our findings regarding the salience of the number of supplementary assessments offered and completed provides a complementary view of this consideration regarding cognitive ability. On the one hand, students who received a higher number of supplementary assessments across the first 3 years of their coursework performed worse overall in terms of professional elements, yet they also evidenced higher levels of linear improvement across their placement series. The former finding likely encompasses the interplay between cognitive ability, self-regulated learning, and other non-cognitive factors such as motivation (Theobald, 2021), whereas the latter primarily reflects the power of feedback (Hattie & Timperley, 2007). Students who undertake supplementary assessments receive additional feedback on their academic and practical performances, which in turn, likely aids learners in developing positive reflective practice strategies (Wisniewski et al., 2020). However, improving knowledge and general skills alone is unlikely to confer significant behavioural change, without attention to salient factors like behavioural skills, attitudes, and habits, and social-structural factors (e.g., social support provision) (Albarracin et al., 2024). Nevertheless, our insights alongside related work from other allied health professionals (Attrill et al., 2012) emphasize the need for physiotherapy programs to consider academic foundations within a multifaceted approach which fosters environments that support diverse learning needs and enhance clinical competency development.

With language a credible determinant for both dimensions of clinical performance, and the country where students completed their high schooling salient for the clinical domain only, our findings suggest there may be potential linguistic and cultural considerations for person-situation interactions for physiotherapy students within the context of clinical placements. These considerations are important for future work, given the growing need for universities and their educators to balance business models that prioritize attracting and retaining international students with commensurate learning experiences that cater for culturally diverse cohorts (Miller et al., 2021). High-quality communication is an important factor for safe and effective patient outcomes across healthcare settings (Institute of Medicine (US) Committee on Quality of Health Care in America, 2001). Language barriers or challenges to effective communication between healthcare practitioners and/or patients are exacerbated by global migration (United Nations, 2020), due to which populations are increasingly linguistically and culturally diverse. Students for whom English is a second language may experience challenges with communication and professionalism dynamics that are central to safe and ethically- and culturally-effective care with patients (e.g., assessment, treatment plans), and high-quality relationships with their primary supervisor and other healthcare practitioners in clinical settings (Al Shamsi et al., 2020). Students whose primary

language is English, yet completed their high school studies at international locations rather than within Australia, might experience variations within K-12 education systems regarding pedagogical priorities (e.g., rote memorisation, critical thinking) and acculturative stressors with studying abroad are likely important considerations. Acculturating from international to Western societies, for example, presents diverse lifestyle changes that might be experienced as stressors, including language, educational environments (e.g., mismatch in expectations of their own academic performance and quality of teaching), sociocultural factors (e.g., friendships), discrimination, and financial burdens (Attrill et al., 2016; Smith & Khawaja, 2011). International students also need to negotiate different university and healthcare structures and systems, which may differ vastly from their home country (McKenna et al., 2017). Considering these challenges, it is imperative for physiotherapy education programs to implement targeted support strategies that address linguistic and cultural barriers, thereby enhancing students' clinical performance and ensuring the delivery of safe, effective, and culturally competent patient care.

Age and gender, which reflect the 'Person' dimension of the PPCT socioecological framework, represent complex demographic factors that we found are important considerations for performance variability in the clinical domain. Gendered experiences and socialisation appear to shape how health profession students navigate clinical learning, primarily regarding interpersonal interactions between students, educators, and healthcare practitioners (Kilminster, 2008). For example, female students more often appraise peer-assisted learning as a relatively "safe" environment for asking questions, expressing uncertainty, and taking time to consolidate understanding, and they rate observing peers' clinical tasks as more useful than do male students (Tai et al., 2017). By contrast, male students are frequently observed to dominate classroom exchanges and display more assertive or competitive behaviours, patterns that may calibrate how they engage with feedback and regulate stress in clinical settings (Babaria et al., 2011). These tendencies are not universal; nevertheless, they underscore the importance of accounting for gendered socialisation when considering learning behaviours and the design of pedagogy within clinical education (Paul et al., 2025). Older students often bring a wide range of life and educational experiences that can influence their engagement and adaptation to diverse, complex experiences within clinical placements. Older students may experience more significant transitional stress or role conflicts (e.g., parenting, caring responsibilities) that may lead to greater variability in performance as they navigate the complexities across social ecologies (e.g., student vs parent) and transitions between different clinical environments (Anderson et al., 2012). Future work is required to unpack the nuanced roles of age and gender for clinical performance variability.

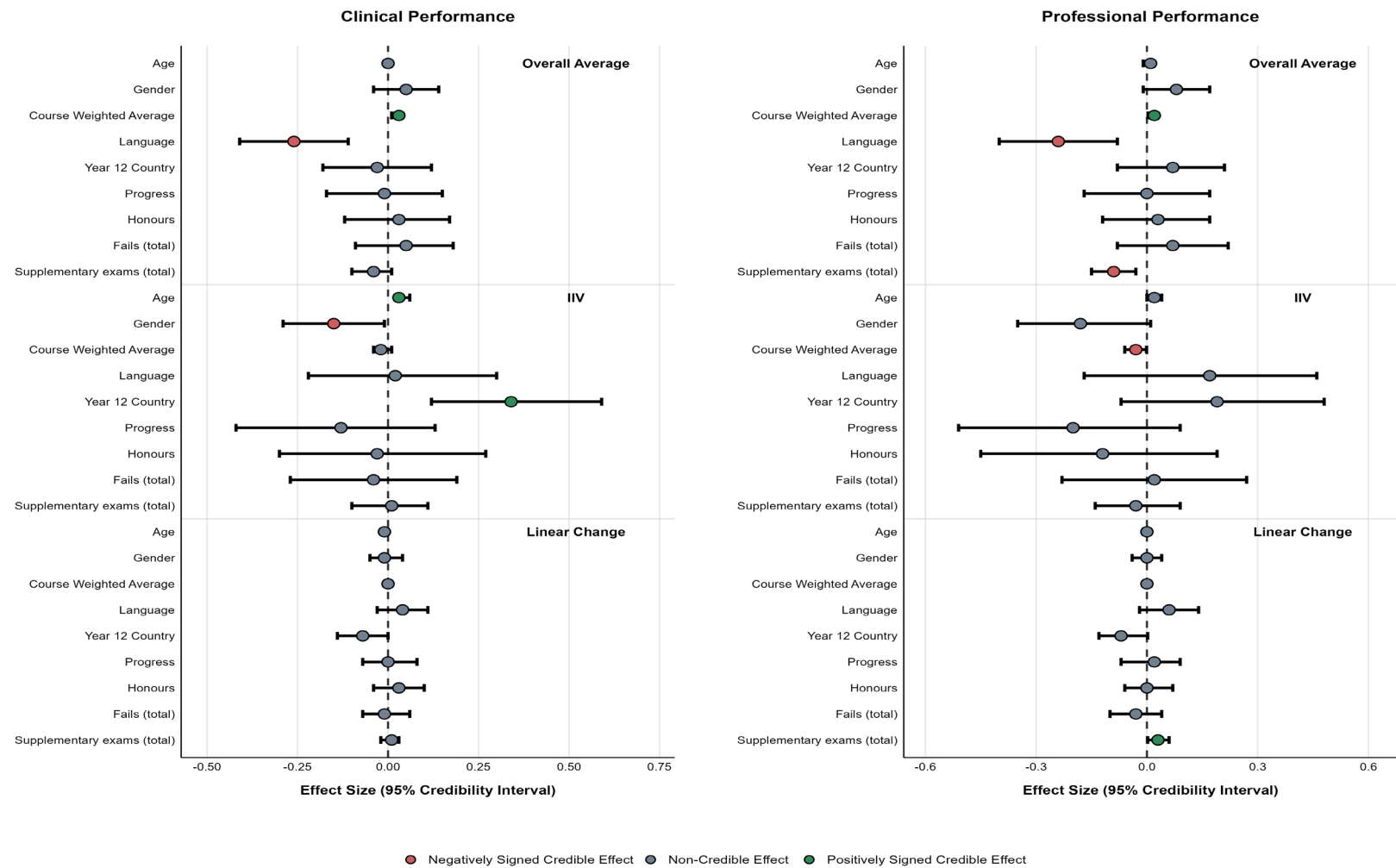
V STRENGTHS AND LIMITATIONS

Strengths of this study are the study design which incorporates temporal and situational dynamics, informant-assessed performance in naturalistic field settings, and a novel way to conceptualize and operationalize clinical performance variability as something of substance rather than nuisance. Nevertheless, our findings are exploratory and therefore, in isolation, should be considered tentative. Our reliance on four cohorts of students from a single university limits the extent to which our findings generalize to other programs in Australia and internationally. We also were limited to demographic and academic factors that were available within archival records. Demographic factors (e.g., age, gender), in particular, are largely non-modifiable, and may reflect other inequities or disadvantages prevalent among students from diverse backgrounds (Attrill et al., 2016; Horwitz et al., 2023; McKenna et al., 2017). There remains a need for large scale, multi-site collaborations that assess diverse time-variant and time-invariant personal and contextual determinants of clinical performance. Doing so will provide robust evidence to inform the early identification of individuals who may require early and/or additional support, and how education providers can best structure curriculum and provide targeted interventions and support to maximize student success in clinical placements.

VI CONCLUSION

Clinical placement learning environments are complex and multifaceted, where performance is often reliant on interdependent relationships between student learners, supervisors, and other clinical and support staff, as well as intersections with the workplace environment, culture, and affordances (Billett, 2008; Patton et al., 2018). We prioritized the student learner in this study, yet acknowledge the need for holistic explorations of the multiple influences on student learning and performance in clinical placements.

Figure 1: Horizontal dot and whisker plot of unstandardized estimates and credibility intervals of determinants of learning curves and consistency in clinical performance.



REFERENCES

- Ajjawi, R., Tai, J., Nghia, T. L. H., Boud, D., Johnson, L., & Patrick, C.-J. (2020). Aligning assessment with the needs of work-integrated learning: The challenges of authentic assessment in a complex context. *Assessment & Evaluation in Higher Education*, 45(2), 304-316. <https://doi.org/10.1080/02602938.2019.1639613>
- Al Shamsi, H., Almutairi, A. G., Al Mashrafi, S., & Al Kalbani, T. (2020). Implications of language barriers for healthcare: A systematic review. *Oman Medical Journal*, 35(2), Article e122. <https://doi.org/10.5001/omj.2020.40>
- Arnett, J. J. (2018). Conceptual foundations of emerging adulthood. In J. L. Murray & J. J. Arnett (Eds.), *Emerging Adulthood and Higher Education* (1st ed., pp. 11–24). Routledge. <https://doi.org/10.4324/9781315623405-2>
- Asparouhov, T., & Muthén, B. (2010). *Bayesian analysis using Mplus: Technical implementation*. <https://www.statmodel.com/download/Bayes3.pdf>
- Attrill, S., Lincoln, M., & McAllister, S. (2012). Student diversity and implications for clinical competency development amongst domestic and international speech-language pathology students. *International Journal of Speech-Language Pathology*, 14(3), 260–270. <https://doi.org/10.3109/17549507.2011.652172>
- Attrill, S., McAllister, S., & Lincoln, M. (2016). Predictors of professional placement outcome: Cultural background, English speaking and international student status. *Perspectives on Medical Education*, 5(4), 222–230. <https://doi.org/10.1007/s40037-016-0289-x>
- Australian Physiotherapy Council. (2025a). Guidelines for accreditation: Entry-level physiotherapy practitioner programs of study V7.0. <https://cdn.physiocouncil.com.au/assets/volumes/downloads/Guidelines-for-accreditation-2025.pdf>
- Australian Physiotherapy Council. (2025b). *Accreditation Standards for Entry-level Physiotherapy Practitioner Programs*. <https://cdn.physiocouncil.com.au/assets/volumes/downloads/Accreditation-Standards.pdf>
- Ball, I., Banerjee, M., Holliman, A., & Tyndall, I. (2024). Investigating success in the transition to university: A systematic review of personal risk and protective factors influencing academic achievement. *Educational Psychology Review*, 36(52). <https://doi.org/10.1007/s10648-024-09891-0>
- Babaria, P., Bernheim, S., & Nunez-Smith, M. (2011). Gender and the pre-clinical experiences of female medical students: a taxonomy. *Medical Education*, 45(3), 249–260. <https://doi.org/10.1111/j.1365-2923.2010.03856.x>
- Bayliss, A. J., & Strunk, V. A. (2015). Measurement of empathy changes during a physical therapist's education and beyond. *Journal of Physical Therapy Education*, 29(2), 6–12. <https://doi.org/10.1097/00001416-201529020-00003>
- Bell, A., Borges Dario, A., Klinner, C., Nisbet, G., Penman, M., Storer, D., & Monrouxe, L. (2024). Improving the quality of allied health placements: Student, educator and organisational preparedness. *Studies in Continuing Education*, 47(1), 1–23. <https://doi.org/10.1080/0158037X.2024.2360495>
- Billett, S. (1992). Towards a theory of workplace learning. *Studies in Continuing Education*, 14(2), 143–155. <https://doi.org/10.1080/0158037920140205>
- Billett, S. (2001). Learning through work: Workplace affordances and individual engagement. *Journal of Workplace Learning*, 13(5), 209–214. <https://doi.org/10.1108/EUM0000000005548>

- Billett, S. (2004). Workplace participatory practices: Conceptualising workplaces as learning environments. *Journal of Workplace Learning*, 16(6), 312–324.
<https://doi.org/10.1108/13665620410550295>
- Billett, S. (2006). Relational interdependence between social and individual agency in work and working life. *Mind, Culture, and Activity*, 13(1), 53–69.
https://doi.org/10.1207/s15327884mca1301_5
- Billett, S. (2008). Learning through work: Exploring instances of relational interdependencies. *International Journal of Educational Research*, 47(4), 232–240.
<https://doi.org/10.1016/j.ijer.2008.07.006>
- Billett, S. (2009a). Conceptualizing learning experiences: Contributions and mediations of the social, personal, and brute. *Mind, Culture, and Activity*, 16(1), 32–47.
<https://doi.org/10.1080/10749030802477317>
- Billett, S. (2009b). Personal epistemologies, work and learning. *Educational Research Review*, 4(3), 210–219. <https://doi.org/10.1016/j.edurev.2009.06.001>
- Billett, S. (2024). Constituting integration in work-integrated education and learning. *Studies in Continuing Education*. <https://doi.org/10.1080/0158037X.2024.2363262>
- Bourne, E., Short, K., McAllister, L., & Nagarajan, S. V. (2019). The quantitative impact of placements on allied health time use and productivity in healthcare facilities: A systematic review with meta-analysis. *Focus on Health Professional Education: A Multi-Professional Journal*, 20(2), 8–40.
- Bowles, K., Haines, T., Molloy, E., Maloney, S., Kent, F., Sevenhuysen, S., & Tai, J. (2014). *The costs and benefits of providing undergraduate student clinical placements for a health service organisation: An Evidence Check rapid review brokered by the Sax Institute for the Hunter and Coast Interdisciplinary Training Network through the Health Education Training Institute (HETI)*. Health Education Training Institute.
<https://www.saxinstitute.org.au/wp-content/uploads/The-costs-and-benefits-of-providing-undergraduate-student-clinical-place....pdf>
- Brooks, S., Milne, M., Orr, R. M., & Terry, R. (2017). Is a students' ability to critically self-reflect, related to their performance on physiotherapy clinical placements? *Australian Journal of Clinical Education*, 1(1), Article 6. <https://doi.org/10.53300/001c.5090>
- Calo, M., Judd, B., Chipchase, L., Blackstock, F., & Peiris, C. L. (2022). Grit, resilience, mindset, and academic success in physical therapist students: A cross-sectional, multicenter study. *Physical Therapy*, 102(6), 1–10. <https://doi.org/10.1093/ptj/pzac038>
- Chipchase, L. S., Buttrum, P. J., Dunwoodie, R., Hill, A. E., Mandrusiak, A., & Moran, M. (2012). Characteristics of student preparedness for clinical learning: Clinical educator perspectives using the Delphi approach. *BMC Medical Education*, 12, Article 112.
<https://doi.org/10.1186/1472-6920-12-112>
- Chisholm-Burns, M. A., Berg-Poppe, P., Spivey, C. A., Karges-Brown, J., & Pithan, A. (2021). Systematic review of noncognitive factors influence on health professions students' academic performance. *Advances in Health Sciences Education*, 26(4), 1373–1445.
<https://doi.org/10.1007/s10459-021-10042-1>
- Clouder, L., & Adefila, A. (2017). Empowerment of physiotherapy students on placement: The interplay between autonomy, risk, and responsibility. *Physiotherapy Theory and Practice*, 33(11), 859–868. <https://doi.org/10.1080/09593985.2017.1357153>
- Clouder, L., Jones, M., Mackintosh, S., & Adefila, A. (2022). Development of autonomy on placement: Perceptions of physiotherapy students and educators in Australia and the United Kingdom. *Physiotherapy Theory and Practice*, 38(12), 2100–2110.
<https://doi.org/10.1080/09593985.2021.1898066>

- Cooper, L. L., Orrell, J., & Bowden, M. (2010). *Work integrated learning: A guide to effective practice*. Routledge. <https://doi.org/10.4324/9780203854501>
- Dalal, R. S., Alaybek, B., & Lievens, F. (2020). Within-person job performance variability over short timeframes: Theory, empirical research, and practice. *Annual Review of Organizational Psychology and Organizational Behavior*, 7(1), 421–449. <https://doi.org/10.1146/annurev-orgpsych-012119-045350>
- Dalton, M., Davidson, M., & Keating, J. L. (2011). The Assessment of Physiotherapy Practice (APP) is a valid measure of professional competence of physiotherapy students: A cross-sectional study with Rasch analysis. *Journal of Physiotherapy*, 57(4), 239–246. [https://doi.org/10.1016/s1836-9553\(11\)70054-6](https://doi.org/10.1016/s1836-9553(11)70054-6)
- Dalton, M., Davidson, M., & Keating, J. L. (2012). The Assessment of Physiotherapy Practice (APP) is a reliable measure of professional competence of physiotherapy students: A reliability study. *Journal of Physiotherapy*, 58(1), 49–56. [https://doi.org/10.1016/S1836-9553\(12\)70072-3](https://doi.org/10.1016/S1836-9553(12)70072-3)
- Delany, C., & Bragge, P. (2009). A study of physiotherapy students' and clinical educators' perceptions of learning and teaching. *Medical Teacher*, 31(9), Article e402-411. <https://doi.org/10.1080/01421590902832970>
- Delany, C., Miller, K. J., El-Ansary, D., Remedios, L., Hosseini, A., & McLeod, S. (2015). Replacing stressful challenges with positive coping strategies: A resilience program for clinical placement learning. *Advances in Health Sciences Education*, 20(5), 1303–1324. <https://doi.org/10.1007/s10459-015-9603-3>
- Dickson, T. J., & Darcy, S. (2021). A question of time: A brief systematic review and temporal extension of the socioecological framework as applied in sport and physical activity. *Translational Sports Medicine*, 4(2), 163–173. <https://doi.org/10.1002/tsm2.203>
- Dyrbye, L. N., Thomas, M. R., & Shanafelt, T. D. (2006). Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Academic Medicine*, 81(4), 354–373. <https://doi.org/10.1097/00001888-200604000-00009>
- Edgar, S., Mercer, A., & Hamer, P. (2014). Admission interview scores are associated with clinical performance in an undergraduate physiotherapy course: An observational study. *Physiotherapy*, 100(4), 331–335. <https://doi.org/10.1016/j.physio.2014.03.002>
- Fong, C. J., Krou, M. R., Johnston-Ashton, K., Hoff, M. A., Lin, S., & Gonzales, C. (2021). LASSI's great adventure: A meta-analysis of the Learning and Study Strategies Inventory and academic outcomes. *Educational Research Review*, 34, Article 100407. <https://doi.org/10.1016/j.edurev.2021.100407>
- Foo, J., Rivers, G., Ilic, D., Evans, D. J. R., Walsh, K., Haines, T., Paynter, S., Morgan, P., Lincke, K., Lambrou, H., Nethercote, A., & Maloney, S. (2017). The economic cost of failure in clinical education: A multi-perspective analysis. *Medical Education*, 51(7), 740–754. <https://doi.org/10.1111/medu.13266>
- Gallasch, D., Conlon-Leard, A., Hardy, M., Phillips, A., Van Kessel, G., & Stiller, K. (2022). Variable levels of stress and anxiety reported by physiotherapy students during clinical placements: A cohort study. *Physiotherapy*, 114, 38–46. <https://doi.org/10.1016/j.physio.2021.12.002>
- Govaerts, M. J. B., & van der Vleuten, C. P. M. (2013). Validity in work-based assessment: expanding our horizons. *Medical Education*, 47(12), 1164–1174. <https://doi.org/10.1111/medu.12289>
- Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research*, 77(1), 81–112. <https://doi.org/10.3102/003465430298487>

- Higgs, J. (2012). Practice-Based Education Pedagogy: Situated, Capability-Development, Relationship Practice(s). In J. Higgs, R. Barnett, S. Billett, M. Hutchings, & F. Trede (Eds.), *Practice-Based Education* (pp. 71–80). SensePublishers. https://doi.org/10.1007/978-94-6209-128-3_6
- Higgs, J., Jones, M., Loftus, S., & Christensen, N. (2008). *Clinical reasoning in the health professions* (3rd ed.). Elsevier (Butterworth Heinemann).
- Horwitz, H. M., Struckmeyer, L. R., MacPherson, K. L., Morgan-Daniel, J., Gerry, G., & Myers, C. (2023). Predictors of clinical experience performance in occupational therapy and physiotherapy: A scoping review. *Australian Occupational Therapy Journal*, 70(4), 514–532. <https://doi.org/10.1111/1440-1630.12863>
- Institute of Medicine (US) Committee on Quality of Health Care in America. (2001). *Crossing the quality chasm: A new health system for the 21st Century*. National Academies Press (US). <https://doi.org/10.17226/10027>
- Judd, B., Brentnall, J., Scanlan, J. N., Thomson, K., Blackstock, F., Mandrusiak, A., Chipchase, L., Phillips, A., & McAllister, S. (2023). Evaluating allied health students' readiness for placement learning. *BMC Medical Education*, 23(1), Article 70. <https://doi.org/10.1186/s12909-023-04005-w>
- Judd, B., Fethney, J., Alison, J., Waters, D., & Gordon, C. (2018). Performance in simulation is associated with clinical practice performance in physical therapist students. *Journal of Physical Therapy Education*, 32(1), 94–99. <https://doi.org/10.1097/jte.0000000000000024>
- Kilminster, S. (2008). Gender differences in learning clinical skills – are they significant? *Focus on Health Professional Education: A Multi-Professional Journal*, 10(2), 54–56. <https://search.informit.org/doi/10.3316/informit.464495061518699>
- Kurunsaari, M., Tynjälä, P., & Piirainen, A. (2022). Stories of professional development in physiotherapy education. *Physiotherapy Theory and Practice*, 38(11), 1742–1755. <https://doi.org/10.1080/09593985.2021.1888341>
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511815355>
- Lawton, V., Jones, T. M., & Dean, C. M. (2021). Students achieve comparable performance scores for clinical placements in public and private sectors: a longitudinal observational study. *Journal of Physiotherapy*, 67(1), 56–61. <https://doi.org/10.1016/j.jphys.2020.12.001>
- Lawton, V., Pacey, V., Jones, T. M., & Dean, C. M. (2023). The factors affecting work readiness during the transition from university student to physiotherapist in Australia. *Higher Education, Skills and Work-based Learning*, 14(3), 681–693. <https://doi.org/10.1108/HESWBL-10-2023-0287>
- LeBlanc, V. R. (2009). The effects of acute stress on performance: Implications for health professions education. *Academic Medicine*, 84(10 Suppl), S25–S33. <https://doi.org/10.1097/ACM.0b013e3181b37b8f>
- Levy, R., & McNeish, D. (2023). Perspectives on Bayesian inference and their implications for data analysis. *Psychological Methods*, 28(3), 719–739. <https://doi.org/10.1037/met0000443>
- Lewis, E. (2010). Emotional intelligence as a predictor for clinical performance in professional physical therapy students. *The Internet Journal of Allied Health Sciences and Practice*, 8(4), Article 6.

- Lewis, E. (2011). Longitudinal assessment of emotional intelligence in doctor of physical therapy students. *The Internet Journal of Allied Health Sciences and Practice*, 9(2), Article 11.
- Lindquist, I., Engardt, M., Garnham, L., Poland, F., & Richardson, B. (2006). Development pathways in learning to be a physiotherapist. *Physiotherapy Research International*, 11(3), 129–139. <https://doi.org/10.1002/pri.332>
- Lindquist, I., Engardt, M., & Richardson, B. (2010). Learning to be a physiotherapist: A metasynthesis of qualitative studies. *Physiotherapy Research International*, 15(2), 103–110. <https://doi.org/10.1002/pri.461>
- McBride, L.-J., Fitzgerald, C., Costello, C., & Perkins, K. (2020). Allied health pre-entry student clinical placement capacity: Can it be sustained? *Australian Health Review*, 44(1), 39–46. <https://doi.org/10.1071/AH18088>
- McBride, L.-J., Fitzgerald, C., Morrison, L., & Hulcombe, J. (2015). Pre-entry student clinical placement demand: Can it be met? *Australian Health Review*, 39(5), 577–581. <https://doi.org/10.1071/AH14156>
- McGivern, E., Mandrusiak, A., Rahmann, A., & Forbes, R. (2025). “This patient is not appropriate”: Perspectives of physiotherapy students and clinical educators on exposing students to patients with complex needs during clinical practice placements. *Physiotherapy Theory and Practice*, 41(3), 617–632. <https://doi.org/10.1080/09593985.2024.2355243>
- McKenna, L., Robinson, E., Penman, J., & Hills, D. (2017). Factors impacting on psychological wellbeing of international students in the health professions: A scoping review. *International Journal of Nursing Studies*, 74, 85–94. <https://doi.org/10.1016/j.ijnurstu.2017.06.007>
- McNeish, D. (2021). Specifying location-scale models for heterogeneous variances as multilevel SEMs. *Organizational Research Methods*, 24(3), 630–653. <https://doi.org/10.1177/1094428120913083>
- Milgate, W., Copley, J., & Hill, J. (2024). Failing professional practice placements in allied health: What do we understand about the student experience? A scoping review. *Advances in Health Sciences Education*, 29(1), 301–327. <https://doi.org/10.1007/s10459-023-10243-w>
- Miller, K., Cunningham, J., & Lehmann, E. (2021). Extending the university mission and business model: influences and implications. *Studies in Higher Education*, 46(5), 915–925. <https://doi.org/10.1080/03075079.2021.1896799>
- Milne, N., Louwen, C., Reidlinger, D., Bishop, J., Dalton, M., & Crane, L. (2019). Physiotherapy students’ DiSC behaviour styles can be used to predict the likelihood of success in clinical placements. *BMC Medical Education*, 19(1), Article 379. <https://doi.org/10.1186/s12909-019-1825-2>
- Muthén, L. K., & Muthén, B. O. (2017). Mplus user’s guide: Eighth edition. https://www.statmodel.com/download/usersguide/MplusUserGuideVer_8.pdf
- Nisbet, G., McAllister, S., Morris, C., & Jennings, M. (2021). Moving beyond solutionism: Re-imagining placements through an activity systems lens. *Medical Education*, 55(1), 45–54. <https://doi.org/10.1111/medu.14345>
- Nisbet, G., Thompson, T., McAllister, S., Brady, B., Christie, L., Jennings, M., Kenny, B., & Penman, M. (2023). From burden to benefit: A multi-site study of the impact of allied health work-based learning placements on patient care quality. *Advances in Health Sciences Education*, 28(3), 759–791. <https://doi.org/10.1007/s10459-022-10185-9>

- Patton, N., Higgs, J., & Smith, M. (2013). Using theories of learning in workplaces to enhance physiotherapy clinical education. *Physiotherapy Theory and Practice*, 29(7), 493–503. <https://doi.org/10.3109/09593985.2012.753651>
- Patton, N., Higgs, J., & Smith, M. (2018). Clinical learning spaces: Crucibles for practice development in physiotherapy clinical education. *Physiotherapy Theory and Practice*, 34(8), 589–599. <https://doi.org/10.1080/09593985.2017.1423144>
- Paul, C. R., Chheda, S., Beck Dallaghan, G., Rusch, R. B., Strand, K. J., Zarvan, S. J., & Hanson, J. L. (2025). Gender bias in patient care learning experiences: Reflective writings of third-year medical students. *Medical Science Educator*, 35(1), 447–458. <https://doi.org/10.1007/s40670-024-02216-4>
- Paynter, S., Iles, R., & Hay, M. (2022). An investigation of the predictive validity of selection tools on performance in physiotherapy training in Australia. *Physiotherapy*, 114, 1–8. <https://doi.org/10.1016/j.physio.2021.11.001>
- Physiotherapy Board of Australia & Physiotherapy Board of New Zealand. (2023). *Physiotherapy practice thresholds in Australia & Aotearoa New Zealand*. <https://www.physiotherapyboard.gov.au/Accreditation.aspx>
- Ployhart, R. E., Nyberg, A. J., Reilly, G., & Maltarich, M. A. (2014). Human capital is dead; Long live human capital resources! *Journal of Management*, 40(2), 371–398. <https://doi.org/10.1177/0149206313512152>
- Reubenson, A., Ng, L., & Gucciardi, D. F. (2020). The Assessment of Physiotherapy Practice tool provides informative assessments of clinical and professional dimensions of student performance in undergraduate placements: a longitudinal validity and reliability study. *Journal of Physiotherapy*, 66(2), 113–119. <https://doi.org/10.1016/j.jphys.2020.03.009>
- Reubenson, A., Ng, L., Lawton, V., Nahon, I., Terry, R., Baldwin, C., Blackford, J., Bond, A., Corrigan, R., Dalton, M., Dario, A. B., Donovan, M., Dunwoodie, R., Dwyer, G. M., Forbes, R., Francis-Cracknell, A., Gill, J., Hams, A., Jones, A., . . . Gucciardi, D. F., on behalf of the Physiotherapy Clinical Education Research Collaborative. (2025). The Assessment of Physiotherapy Practice is a robust measure of entry-level physiotherapy standards: Reliability and validity evidence from a large, representative sample. *PLoS One*, 20(4), Article e0321397. <https://doi.org/10.1371/journal.pone.0321397>
- Reynolds, K., Bazemore, C., Hanebuth, C., Hendren, S., & Horn, M. (2021). The relationship of non-cognitive factors to academic and clinical performance in graduate rehabilitation science students in the United States: a systematic review. *Journal of Educational Evaluation for Health Professions*, 18, Article 31. <https://doi.org/10.3352/jeehp.2021.18.31>
- Richardson, M., Abraham, C., & Bond, R. (2012). Psychological correlates of university students' academic performance: A systematic review and meta-analysis. *Psychological Bulletin*, 138(2), 353–387. <https://doi.org/10.1037/a0026838>
- Rogoff, B. (1990). *Apprenticeship in Thinking: Cognitive Development in Social Context*. Oxford University Press. <https://doi.org/10.1093/oso/9780195059731.001.0001>
- Ryall, T., Preston, E., Mahendran, N., & Bissett, B. (2022). Impact of classroom-based MASK-ED™ (KRS simulation) on physiotherapy student clinical performance: A randomized cluster trial. *BMC Medical Education*, 22(1), Article 426. <https://doi.org/10.1186/s12909-022-03467-8>
- Schmutz, A., Meyer, I., & Archer, E. (2021). Supervision interactions and student learning: How supervision can influence learning. *Physiotherapy Theory and Practice*, 37(2), 315–322. <https://doi.org/10.1080/09593985.2019.1628139>

- Schrewe, B., Ellaway, R. H., Watling, C., & Bates, J. (2018). The contextual curriculum: Learning in the matrix, learning from the matrix. *Academic Medicine*, 93(11), 1645–1651. <https://doi.org/10.1097/acm.0000000000002345>
- Sellberg, M., Halvarsson, A., Nygren-Bonnier, M., Palmgren, P. J., & Möller, R. (2022). Relationships matter: A qualitative study of physiotherapy students' experiences of their first clinical placement. *Physical Therapy Reviews*, 27(6), 477–485. <https://doi.org/10.1080/10833196.2022.2106671>
- Smith, B., Robson, K., Robinson, C., & Patton, N. (2023). Factors influencing provision of clinical placements for health students: A scoping review. *Focus on Health Professional Education: A Multi-Professional Journal*, 24(2), 63–103. <https://doi.org/10.11157/fohpe.v24i2.562>
- Smith, R. A., & Khawaja, N. G. (2011). A review of the acculturation experiences of international students. *International Journal of Intercultural Relations*, 35(6), 699–713. <https://doi.org/10.1016/j.ijintrel.2011.08.004>
- So, O. W., Shaw, R., O'Rourke, L., Woldegabriel, J. T., Wade, B., Quesnel, M., & Mori, B. (2019). Clinical instructors' experiences working with and assessing students who perform below expectations in physical therapy clinical internships. *Physiotherapy Canada*, 71(4), 391–399. <https://doi.org/10.3138/ptc-2018-0081>
- Solvang, P. K., & Fougner, M. (2023). Learning from clinical placement experience: how do undergraduate physiotherapy students approach person-centered practice? *Physiotherapy Theory and Practice*, 39(12), 2609–2624. <https://doi.org/10.1080/09593985.2022.2089609>
- Stasielowicz, L. (2020). How important is cognitive ability when adapting to changes? A meta-analysis of the performance adaptation literature. *Personality and Individual Differences*, 166, Article 110178. <https://doi.org/10.1016/j.paid.2020.110178>
- Stoikov, S., Maxwell, L., Butler, J., Shardlow, K., Gooding, M., & Kuys, S. (2022). The transition from physiotherapy student to new graduate: Are they prepared? *Physiotherapy Theory and Practice*, 38(1), 101–111. <https://doi.org/10.1080/09593985.2020.1744206>
- Tai, J. H., Canny, B. J., Molloy, E. K., & Haines, T. P. (2017). Gender matters: Students' perceptions of peer learning in clinical education. *Focus on Health Professional Education: A Multi-Professional Journal*, 18(1), 3–15. <https://search.informit.org/doi/10.3316/informit.887561396673034>
- Terry, R., Hing, W., Orr, R., & Milne, N. (2017). Do coursework summative assessments predict clinical performance? A systematic review. *BMC Medical Education*, 17, Article 40. <https://doi.org/10.1186/s12909-017-0878-3>
- Terry, R., Hing, W., Orr, R., & Milne, N. (2020). Relationships between pre-clinical summative assessment scores and the clinical performance of physiotherapy students. *Journal of Allied Health*, 49(1), e13–e19.
- Theobald, M. (2021). Self-regulated learning training programs enhance university students' academic performance, self-regulated learning strategies, and motivation: A meta-analysis. *Contemporary Educational Psychology*, 66, Article 101976. <https://doi.org/10.1016/j.cedpsych.2021.101976>
- Tigelaar, D. E. H., & van der Vleuten, C. P. M. (2014). Assessment of Professional Competence. In S. Billett, C. Harteis, & H. Gruber (Eds.), *International Handbook of Research in Professional and Practice-based Learning* (pp. 1237–1270). Springer Netherlands. https://doi.org/10.1007/978-94-017-8902-8_45
- Tucker, B., Jones, S., Mandy, A., & Gupta, R. (2006). Physiotherapy students' sources of stress, perceived course difficulty, and paid employment: Comparison between Western

- Australia and United Kingdom. *Physiotherapy Theory and Practice*, 22(6), 317–328.
<https://doi.org/10.1080/09593980601059550>
- United Nations. (2020). *International Migrant Stock*.
<https://www.un.org/development/desa/pd/content/international-migrant-stock>
- Van Iddekinge, C. H., Aguinis, H., Mackey, J. D., & DeOrtentiis, P. S. (2018). A meta-analysis of the interactive, additive, and relative effects of cognitive ability and motivation on performance. *Journal of Management*, 44(1), 249–279.
<https://doi.org/10.1177/0149206317702220>
- Vygotsky, L. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press.
- Walsh, J. M., Feeney, C., Hussey, J., & Donnellan, C. (2010). Sources of stress and psychological morbidity among undergraduate physiotherapy students. *Physiotherapy*, 96(3), 206–212. <https://doi.org/10.1016/j.physio.2010.01.005>
- Wells, C., Olson, R., Bialocerkowski, A., Carroll, S., Chipchase, L., Reubenson, A., Scarvell, J. M., & Kent, F. (2021). Work readiness of new graduate physical therapists for private practice in Australia: Academic faculty, employer, and graduate perspectives. *Physical Therapy*, 101(6). <https://doi.org/10.1093/ptj/pzab078>
- Wisniewski, B., Zierer, K., & Hattie, J. (2020). The power of feedback revisited: A meta-analysis of educational feedback research. *Frontiers in Psychology*, 10, Article 3087.
<https://doi.org/10.3389/fpsyg.2019.03087>
- World Physiotherapy. (2021). *Physiotherapist education framework*.
<https://world.physio/sites/default/files/2021-07/Physiotherapist-education-framework-FINAL.pdf>
- World Physiotherapy. (2023a). *Policy statement: Education*. London, UK: World Physiotherapy. Retrieved 27 August 2024 from <https://world.physio/policy/ps-education>
- World Physiotherapy. (2023b). *Policy statement: Standards of physiotherapist practice*. London, UK: World Physiotherapy. Retrieved 27 August 2024 from <https://world.physio/policy/ps-standards>
- Wright, A., Moss, P., Dennis, D. M., Harrold, M., Levy, S., Furness, A. L., & Reubenson, A. (2018). The influence of a full-time, immersive simulation-based clinical placement on physiotherapy student confidence during the transition to clinical practice. *Advances in Simulation*, 3(3). <https://doi.org/10.1186/s41077-018-0062-9>