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Career decision-making self-efficacy after a discipline-specific career course for art and design students: a single-group, three-wave explanatory mixed-methods evaluation

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Abstract

Background. Art and design students enter non-standardised, portfolio- and project-based careers that generic career education may fit poorly. Existing course evaluations show immediate gains in career decision-making self-efficacy that can attenuate within weeks and seldom examine how students perceive these changes. Evidence is limited for discipline-specific provision delivered as routine teaching to Chinese art and design students. We evaluated immediate change and six-week maintenance in career decision-making self-efficacy, immediate change in career adaptability, and students' experiences.

Methods. This was a single-group, three-wave, prospective, explanatory sequential mixed-methods evaluation of routine teaching. Eight intact classes of art and design students took a foundational module and four discipline-specific sessions. Career decision-making self-efficacy was measured before the course, immediately after, and six weeks later; career adaptability before and immediately after; plus acceptability and behaviour. Linear mixed models estimated three pre-specified contrasts, with inverse-probability-weighting and pattern-mixture sensitivity analyses; 18 post-course interviews sampled across change trajectories were framework-analysed and integrated in a joint display.

Results. Of 210 consented adults, valid self-efficacy data were available for 198, 179, and 154 across waves (73.3% retention). Self-efficacy rose immediately (0.130, 95% CI 0.082 to 0.178; standardised 0.27) and remained above baseline at follow-up (0.095, 0.045 to 0.146; standardised 0.20), with a small, uncertain change afterwards (−0.035, −0.086 to 0.017). The immediate estimate remained positive across sensitivity analyses. The baseline-to-follow-up estimate remained positive within the pre-specified range, but its confidence interval included zero under larger post-hoc departures from the missing-at-random assumption. Career adaptability rose modestly (0.171; standardised 0.28). Students attributed early gains to profiling and information activities and later attenuation to interrupted feedback and competing tasks.

Conclusions. Career decision-making self-efficacy scores increased from baseline to the immediate post-course assessment and remained above baseline at six weeks. Given the uncontrolled design and selective attrition, these temporal changes cannot be attributed to the course. Interviews described factors that students perceived as related to maintenance or attenuation and suggested candidate course revisions.

Keywords

career planning education; career decision-making self-efficacy; career adaptability; art and design students; mixed methods; qualitative interviews

Introduction

Graduates of art and design programmes enter labour markets whose structure differs markedly from the standardised, position-based pathways assumed by much generic career education. Creative careers are frequently portfolio-based and project-based, combine salaried employment with self-employment, freelancing, studio practice, and portfolio ("protean") arrangements, and are increasingly reshaped by artificial-intelligence and digital tools that alter the skills students expect to sell [1]. Occupational value in these fields is often established through a personal body of work, direct client and collaborator relationships, and informal industry networks rather than through formal credentials alone. For students, this environment raises specific, non-trivial decision tasks: appraising their own competencies, interests, and portfolio strengths; locating trustworthy information about roles, platforms, income structures, and client work; and translating creative ability into a viable occupational plan under conditions of income uncertainty and family expectation. Self-perceived employability is itself a resource for navigating such uncertainty [2], and career adaptability and job-search self-efficacy predict school-to-work outcomes among Chinese graduates [3].

Career development among arts, creative, and humanities students has been examined in several settings. First-year arts, English, and language students report distinctive career decision-making and employability concerns [4], and pilot career activities for first-year arts students have been described [5]. However, several evaluations rely on unmatched or anonymous survey waves, self-selected participation, or short follow-up windows. Their limitations leave uncertainty about how discipline-specific career provision embedded in routine teaching relates to individually matched change over time among Chinese art and design students, whether any immediate change is maintained over the following weeks, and how students account for these patterns.

Career decision-making self-efficacy (CDMSE) refers to a person's confidence in their ability to complete the tasks required to make and enact career decisions, and derives from self-efficacy theory and social cognitive career theory [6–9]; it has been meta-analytically linked to career decidedness and related outcomes [10]. It is typically organised around five task domains — accurate self-appraisal, gathering occupational information, goal selection, planning, and problem solving. For a short course, CDMSE is arguably the most direct psychological outcome to expect, because these five domains map closely onto what career

instruction can plausibly influence within a few weeks: clarifying self-knowledge, teaching information-search strategies, structuring goal comparison, and rehearsing planning and problem solving. Social cognitive career theory further implies an ordering: confidence in domains directly targeted by information and exploration activities (information gathering, self-appraisal) should respond earliest, whereas planning confidence, which depends on sustained rehearsal and feedback, may be the least durable once a short course ends. In the present study CDMSE is measured with the 39-item scale developed for Chinese undergraduates by Peng and Long [11], and its total mean serves as the single primary quantitative indicator, with the five domain scores retained as secondary, interpretive analyses, not co-primary outcomes.

Career adaptability, as articulated within career construction theory, describes the self-regulatory resources — concern, control, curiosity, and confidence — that help individuals manage occupational tasks and transitions [12–14]; career adaptability and career decision-making self-efficacy are moderately associated across studies [15], and both relate to career choice satisfaction [16]. It was measured at baseline and immediately post-course with the short-form Career Adapt-Abilities Scale validated in the Chinese context [17] and treated as a secondary outcome; mediation was not evaluated.

Evidence from existing course evaluations: Pre–post and quasi-experimental evaluations of career planning instruction already exist; meta-analytic and systematic-review evidence indicates that career interventions produce small-to-moderate gains, with career decision-making self-efficacy among the most responsive outcomes [18–19], and brief or course-based programmes have shown similar effects in university samples [20–22]. Most relevant here, a recent quasi-experimental study of a five-week career planning course among Chinese undergraduates reported immediate gains in both career adaptability and career decision-making self-efficacy, with some attenuation of the self-efficacy gain by an approximately four-week follow-up, and its authors noted the absence of process and mechanism measures [23]. That pattern — an immediate change that may or may not persist — is the focus of the present study, which examines whether CDMSE changes immediately, whether the change is maintained, further increases, or attenuates over six weeks, and how students perceive the processes involved. Reference [23] appeared online during our data-collection period and is considered only as a post-hoc comparator.

Because the present study differs from the quasi-experimental study above in instrument (the 39-item scale [11] here versus a 25-item short form [24]), response anchors, population, follow-up window, and design, comparisons are limited to the direction of construct-level

change and maintenance-versus-attenuation patterns. Raw means, raw change scores, and non-converted effect sizes are not compared.

Repeated surveys can describe average change and its uncertainty, but they cannot identify the processes students perceived as supporting or hindering that change or the discipline-specific conditions shaping the move from intention to action. We therefore adopted an explanatory sequential mixed-methods design (QUAN → qual → integration), in which quantitative trajectories informed purposive sampling for individual interviews and the two strands were connected and jointly interpreted [25–27]. Interviews were sampled by linking each student's immediate change (T0→T1) and subsequent change (T1→T2), so that maintenance, further increase, attenuation, delayed improvement, and recovery were represented. Integration was used to contextualise the quantitative results and identify candidate course revisions.

This study is a prospective mixed-methods evaluation of a discipline-specific career planning course delivered as routine teaching to art and design students at a single Chinese institution. There was no randomisation and no research-controlled comparison group; accordingly, maturation, concurrent institutional activities, repeat-testing, self-selection into the research, and unmeasured factors cannot be excluded, and the findings are interpreted as changes associated with course participation rather than as course effects. We address the following questions:

1. RQ1 (core). Does art and design students' career decision-making self-efficacy change from before the course (T0) to immediately afterwards (T1)?
2. RQ2 (core). Is any T0→T1 change maintained, further increased, or attenuated at the six-week follow-up (T2)?
3. RQ3. Does career adaptability change from T0 to T1?
4. RQ4. How do students appraise the course's relevance, comprehensibility, applicability, and overall acceptability, and which self-reported career preparation actions do they report at T2?
5. RQ5. How do students explain increases, stability, or decreases in career decision-making confidence, the maintenance or attenuation of early change, and the ways discipline-specific factors (portfolio, project-based work, freelancing, studio paths, AI, family expectations, industry information) shape the move from planning to action?
6. RQ6. Where do the survey changes and the interview accounts converge, complement, or conflict, and what does this imply for revising the course?

Consistent with the design, the expected direction (higher CDMSE at T1 than T0, on social-cognitive grounds) was used to organise estimation.

Methods

Design and reporting

This was a three-wave, prospective, explanatory sequential mixed-methods evaluation of a career planning course delivered as part of routine teaching (QUAN → qual → integration), with quantitative priority. Quantitative surveys at three time points (T0 before the course, T1 immediately after, T2 at six weeks) described individually matched change in career decision-making self-efficacy, and semi-structured individual interviews after T2 were used to contextualise the quantitative patterns and inform candidate course revisions. Quantitative reporting was informed by STROBE [28], interview reporting by COREQ [29], integration by GRAMMS [26], and course description by the applicable TIDieR [30] items; Additional file 1 summarises guideline applicability and completion, with TREND also mapped. STROBE was the primary framework for this observational evaluation.

The study was not publicly registered or pre-registered. Ethics-approved materials formed the pre-implementation record. The outcome hierarchy and analysis rules were consolidated after data collection but before the recorded data lock and outcome analysis; post-hoc analyses are labelled explicitly.

Document versions, dates, the data-lock record, and the distinction between protocol-specified and pre-analysis decisions are provided in Additional file 1.

Setting and participants

The study was conducted at North China University of Water Resources and Electric Power within its routine career-education provision. Participants were students of the 2025 cohort in art and design programmes, comprising eight intact natural classes across four programmes: one painting class, two environmental design classes, two visual communication design classes, one public art class, and two further environmental design classes delivered within a China–Korea joint programme (treated as a distinct teaching context).

Students were eligible if they belonged to one of the eight classes, were aged 18 years or older at T0, could read Chinese and complete the questionnaires independently, provided informed consent, and agreed to linkage of their three survey waves. Data were excluded for students under 18 without an approved guardian-consent procedure, those who declined or withdrew consent, and records that could not be reliably matched.

All eligible adult students were invited; the planning frame was approximately 220 students, and 210 consented at T0. The sample was the fixed teaching population and was not determined by an a priori power calculation. Effect estimates and 95% confidence intervals characterise precision.

The career planning course

The course was delivered to all eight classes as routine teaching. Classroom participation, assignments, and course evaluation followed the school's normal rules.

Content and dose. The course comprised one foundational module ("the first lesson of career education") followed by four discipline-specific sessions, each of approximately 90 minutes (the career-experience session up to 120 minutes), delivered over several weeks between late September and late October 2025 (with institutional holidays interspersed); a career-experience day (careers "carnival") was embedded in the third discipline-specific session. The measurement and teaching sequence was: adult informed consent → T0 → foundational module → E1 → E2 → E3 (experience day) → E4 (action plan) → T1 (3–7 days later) → a six-week natural action window → T2 → individual interviews. T0 was completed before the foundational module so that the immediate influence of that module was not absorbed into baseline.

The foundational module covered career-planning concepts; self, environment, decision, and action; institutional employment and career-development resources; and the diversity of art and design career pathways. The four discipline-specific sessions and their mapping to CDMSE task domains and classroom outputs are summarised in Table 1: E1 (creative career profile and ecology; self-appraisal and information gathering; profile and ecology map), E2 (information exploration and path selection; information gathering and goal selection; information-source table and decision matrix), E3 (career-experience day; goal selection and problem solving; question list and situational solutions), and E4 (creative career action lab; planning and problem solving; a six-week action plan).

Tailoring and its development. The discipline-specific content was fixed before implementation and grounded in the five career-decision task categories of the 39-item scale [11], literature on arts, creative, and design careers, and tasks such as portfolio work, project-based and client work, freelancing, studio practice, and AI-related change. Career-education and art and design teachers reviewed the course manual, and their comments, revision decisions, and version dates were recorded for course development.

Fidelity. For each class, we recorded teaching dates, duration, instructor, completion of core content and classroom activities, classroom outputs, major deviations, and concurrent institutional career activities. These records described implementation and informed interpretation.

Measures

Primary outcome. Career decision-making self-efficacy was measured at T0, T1, and T2 with the 39-item scale developed for Chinese undergraduates [11]. Items use a 1–5 confidence-strength anchor and cover self-appraisal, information gathering, goal selection, planning, and problem solving. The primary indicator was the total-scale mean (range 1.00–5.00).

Three co-equal, pre-specified contrasts were defined: T1−T0, T2−T0, and T2−T1. The summed total was retained only as an auxiliary check, and the five domain scores were secondary, interpretive outcomes rather than co-primary outcomes.

Scores were person-mean prorated when pre-specified completion thresholds were met. Exact thresholds and the handling of partially completed scales are reported in Additional file 1. The CDMSE-39 [11] and CAAS-SF [17] were administered in their published Chinese forms for non-commercial academic research.

Secondary outcome. Career adaptability was measured at T0 and T1 with the 12-item short-form Career Adapt-Abilities Scale validated for the Chinese context [17]. The total-scale mean (range 1.00–5.00) was secondary; its four three-item dimensions—concern, control, curiosity, and confidence—were exploratory. The analysis therefore addresses immediate change in career adaptability.

Course acceptability. At T1, six 5-point items assessed the relevance of the content to art and design careers, help in understanding available pathways, ease of understanding the activities, applicability to real action, willingness to recommend the course to peers, and overall satisfaction. Two open-ended questions asked which activity was most helpful and why, and which part most needed improvement and why. These responses informed interview probes and the implementation appraisal.

Self-reported preparation behaviour. At T2, four yes/no items recorded substantive CV or portfolio updating; participation in a career-planning competition, recruitment activity, internship, innovation-and-entrepreneurship activity, or professional practice; a career conversation with an alumnus, practitioner, mentor, or potential client; and completion of a self-directed task from the action plan.

Students could add a brief description and date, but evidence was not required and no blinded third-party verification was undertaken. These outcomes are therefore described as self-reported preparation behaviour. Exposure to concurrent career activities during follow-up was also recorded (Additional file 1).

Baseline variables. Baseline variables were age; gender; programme and class; membership of the China–Korea joint programme; prior receipt of a systematic career planning course; internship or part-time experience; prior participation in a career-planning or innovation-and-entrepreneurship competition; possession of a portfolio; and whether the student was considering self-employment or freelancing.

Data collection procedure

Data collection ran from September to December 2025. T0 was completed on 26–28 September, the foundational module on 29–30 September, and E1–E4 on 9–31 October. T1 was administered on 3 November, 3–7 days after each class's final session; T2 was administered on 15 December, 42 days after T1; and interviews were conducted on 22–26 December. T2 preceded the university-wide career-experience event held on 16–18 December.

Randomly generated study identifiers linked the waves; the encrypted identity-link file was stored separately. Separate follow-up permission, an online or brief offline make-up option, and two non-coercive reminders were used to limit attrition. The full schedule and data-security procedures are in Additional file 1.

The T2 completion target was ⩾75% of adult T0 consenters. At 70 – 74.9%, RQ2 and the T2 contrasts were to be retained but interpreted with heightened attention to attrition; below 70%, they were to be downgraded to exploratory. The T0→T1 analysis was unaffected.

Interview sampling

Interviewees were selected by purposive maximum-variation sampling from students with valid data at all three waves who had consented to further contact. Candidate lists were generated by a researcher who had no teaching or assessment role. The initial target of approximately 15 interviews could be extended to 18–20.

Each candidate was classified on immediate change (T0→T1), subsequent change (T1→T2), and position at T2 relative to T0. A pre-defined mapping combined these fields into a sampling label; the full mapping and version history are in Additional file 1.

Interview-sampling trajectories were classified using change standardised to the T0 SD with a tolerance of c = 0.20; sensitivity to c = 0.15 and 0.30 is reported in Additional file 1. The pre-specified framework also considered a reliable-change-index approach [31], but it was not applied because the available test–retest evidence did not support common thresholds across all three intervals.

The labels were used only for purposive interview sampling and were not clinical or verified individual-change classifications. Sampling also sought variation by programme, joint-programme context, gender, baseline level, attendance, and T2 behaviour. Detailed integrity checks and priority rules are provided in Additional file 1.

Interview procedure

Interviews were one-to-one and semi-structured, lasted 20–30 minutes, and were conducted 1–2 weeks after T2 in a private campus setting or an approved encrypted online meeting. Two trained female undergraduate research-team members conducted nine interviews each; neither had responsibility for participants' grades, competitions, or employment recommendations.

The neutral ten-question guide covered the pre-course situation, course experience, the five career-decision domains, preparation actions, discipline-specific conditions, maintenance or attenuation, and course revision. Trajectory-informed probes were used without revealing scores or labels.

Interviewing ended after the main trajectories, programmes, and counter-examples were represented and further interviews no longer materially extended the core themes. Training, pilot interviews, field memos, and interviewer–participant relationships are documented in Additional file 1.

Quantitative analysis

The analysis population comprised consenting adults with at least one valid wave, and longitudinal models used all available waves. The covariate-free model included 531 records from 210 participants. The adjusted primary model excluded seven participants with incomplete time-invariant baseline covariates and included 516 records from 203 participants. No participant was excluded because of attendance or observed improvement.

Pre-specified data checks covered duplicate identifiers, assessment windows, ranges, logical consistency, and response quality. Reliability, item distributions, and floor and ceiling effects were examined at each wave. Longitudinal measurement invariance [32–33] was assessed with the five domains as parcels; lack of scalar invariance reduced the interpretive weight placed on mean change. Detailed rules and software versions are in Additional file 1.

The primary analysis was a linear mixed model for the CDMSE total-scale mean. Time was categorical with T0 as the reference; the model included class fixed effects, gender, prior systematic career-course exposure, prior practical experience, and a participant random intercept. Class was treated as fixed because only eight classes were available.

Each co-equal contrast (T1−T0, T2−T0, and T2−T1) was reported as an estimated difference, a 95% confidence interval, and a standardised change. The standardised change divided the model-estimated difference and its interval by the T0 observed-score standard deviation. No family-wise correction was applied to the three co-equal contrasts.

The same time coding was used for secondary CDMSE-domain and CAAS analyses. Acceptability and T2 behaviour were summarised descriptively; non-submission of a behaviour item was not coded as absence.

Pre-specified sensitivity analyses comprised covariate-free and complete-case models, window and baseline-exposure exclusions, likelihood-based estimation under missing at random, stabilised inverse-probability-of-response weighting [34], and a conditional pattern-mixture δ analysis when T2 missingness exceeded 10%. Missing predictors in the response model were stochastically imputed 50 times, with estimates combined across imputations [35]. CR2 class-clustered standard errors were computed as a separate sensitivity analysis [36]. The response model, weight diagnostics, δ grid, stability criteria, and software environment are reported in Additional file 1.

A separate post-hoc analysis examined associations between attendance and change with baseline adjustment and heteroscedasticity-robust and class-clustered uncertainty estimates.

Qualitative analysis

Interviews were analysed with the framework method [37], with inductive theme development informed by reflexive thematic analysis [38]. The deductive framework covered the five CDMSE task domains, course components, discipline-specific context, change and action, and evaluative stance. Seven non-exclusive inductive codes captured cross-cutting themes.

The 18 interviews yielded 180 question–response coding units. One research assistant coded all units, and a second independently double-coded 60 units from six transcripts. Both coders were independent of teaching and assessment and were blind to quantitative trajectories during initial coding; disagreements were discussed and dated.

The analysis actively sought null, negative, recovery, and score–narrative counter-examples. Chinese quotations were translated and checked sentence by sentence by a second bilingual

researcher. The codebook, coder training, translation procedures, reflexivity record, and participant-by-theme matrix are provided in Additional file 1.

Integration

The strands were integrated at three points [26]. Connecting: the T0–T2 survey data defined the purposive interview sampling frame. Building: T1 open-ended items, domain-level changes, and T2 behaviour frequencies shaped interview probes, while the core guide remained fixed before ethics approval. Merging: after separate analyses, a joint display paired quantitative results with qualitative themes and classified their relationships as convergence, complementarity, or discordance. Each entry was checked by at least two researchers to indicate whether it rested on quantitative results, interview themes, both, or the team's interpretive inference.

Ethics and consent

The Institutional Review Board of North China University of Water Resources and Electric Power approved the study (SFSNCWU20250905, 5 September 2025). Written informed consent was obtained from adults at T0, with separate choices for follow-up contact, interviews, audio recording, anonymised quotations, and controlled data sharing.

Research participation was separate from routine teaching. Course access, grades, competitions, and employment services were independent of research participation. Teaching staff had no access to individual responses, and interviewers had no evaluative role. The first author's employment-centre role and contribution to course design are disclosed; grading, competition, and employment decisions for interviewees were handled by others. The pre-specified role-separation procedures are detailed in Additional file 1.

Results

Participant flow and data quality

Participant flow is shown in Figure 1. Across eight classes, 220 students were enrolled, 216 were adults at T0, and 210 consented to the research. The survey platform exported 576 raw records (T0 = 208, T1 = 198, T2 = 170). After pre-specified identifier and response-quality screening, valid CDMSE records numbered 198 at T0 (94.3% of consenters), 179 at T1 (85.2%), and 154 at T2 (73.3%).

No completion fell outside the final assessment windows. Six T0 records with possible recent career-content exposure were retained, with a post-hoc analysis excluding them. Screening

exclusions, implementation deviations, and the full flow are detailed in Figure 1 and Additional file 1.

T2 valid retention was 73.3% (154/210), below the target of ≥75% but above the <70% threshold for downgrading the T2 analyses to exploratory. The maintenance analyses were therefore retained with heightened attention to attrition and reported alongside weighted estimates.

Valid data at all three waves were available for 128 students; 83 of them had consented to interview contact and formed the sampling frame. Of 21 invited students, 18 participated, two declined without a recorded reason, and one did not respond after one reminder. The complete missingness decomposition is shown in Figure 1.

Sample characteristics and attrition

Participant characteristics are summarised in Table 2. The consented sample (N = 210) was 69.5% female, had a mean age of 18.8 years (SD 1.0), and included 56 students (26.7%) from the China–Korea joint programme.

Attrition favoured higher-functioning students. Compared with non-completers, T2 completers had higher baseline and T1 CDMSE, baseline CAAS, attendance, and valid T1 completion (SMDs 0.31–0.62). Prior systematic career-course exposure and prior practical experience were slightly more common among non-completers (SMDs −0.16 and −0.18). These differences informed the weighting and pattern-mixture analyses.

Course implementation and fidelity

All eight classes received all five sessions (Table 3). Across classes, mean core-content coverage was 79.4–93.8%, attendance was 65.4–80.0%, and mean session length was 80.0–96.6 minutes. Deviations, rescheduling, technical problems, and the session-level fidelity log are reported in Additional file 1; all students remained in the analysis.

Concurrent activities during follow-up included lectures, alumni talks, recruitment events, competitions, and a university career carnival on 13–14 November. Because these exposures overlapped the maintenance interval in a single-group design, they are potential confounders of the T2 result. Dates, class coverage, and student reports are provided in Additional file 1.

Measurement properties

Internal consistency of the CDMSE-39 total was adequate to good at each wave (Cronbach's α = .877–.900; McDonald's ω = .880–.902), with no total-scale floor or ceiling responses. The

shorter domains were less consistent (α ≈ .53–.79), and CAAS-SF total α was .80–.82; domain and item diagnostics are in Table 4 and Additional file 1.

The five-parcel longitudinal model supported configural and metric but not full scalar invariance. A minimal partial-scalar model had mixed support across fit-change criteria. Full fit statistics and latent-mean analyses are in Additional file 1.

Primary outcome: career decision-making self-efficacy

Observed CDMSE-39 means were 3.24 (SD 0.48) at T0, 3.38 (SD 0.49) at T1, and 3.40 (SD 0.45) at T2. Figure 2 labels these unadjusted means to three decimals as 3.235, 3.378, and 3.404.

The adjusted primary model included 516 records from 203 participants. Its model-estimated marginal means were 3.243 at T0, 3.372 at T1, and 3.338 at T2. Contrasts were calculated from the unrounded model estimates, giving:

T1−T0: estimated difference 0.130 (95% CI 0.082 to 0.178; d_baseline = 0.27; p < .001);

T2−T0: 0.095 (95% CI 0.045 to 0.146; d_baseline = 0.20; p < .001);

T2−T1: −0.035 (95% CI −0.086 to 0.017; d_baseline = −0.07; p = .19).

The pattern is a small immediate increase, a level at T2 that remained above baseline, and a slight, uncertain decline between T1 and T2 whose confidence interval included zero. The observed T2 mean (3.40) was slightly above the observed T1 mean (3.38), whereas the model estimated a small T2−T1 decrease. T2 completers had higher self-efficacy, so the unadjusted T2 mean describes a different observed subset from the longitudinal model estimate.

Sensitivity and robustness

The T1−T0 estimate was positive across all sensitivity analyses. Covariate-free, three-wave complete-case, and baseline-exposure-exclusion models reproduced positive T1−T0 estimates (0.114–0.130) and T2−T0 estimates (0.059–0.098). T2−T1 remained small and negative but was not consistently distinguishable from zero.

Stabilised inverse-probability weighting gave T1−T0 = 0.129 (95% CI 0.062 to 0.196), T2−T0 = 0.079 (0.014 to 0.143), and T2−T1 = −0.050 (−0.111 to 0.010), with diagnostics within the pre-specified stability criteria. Pattern-mixture analysis across the pre-specified −0.20 to +0.20 × SD(T0) range left T2−T0 positive with intervals excluding zero; at −0.20 SD it was 0.070 (0.013 to 0.126). In the extended post-hoc grid, the lower bound crossed zero at about δ = −0.30 SD. Full diagnostics and the δ grid are in Table 5 and Additional file 1.

CR2 class-clustered estimates were T1−T0 = 0.130 (95% CI 0.063 to 0.196; p = .003), T2−T0 = 0.095 (0.027 to 0.163; p = .013), and T2−T1 = −0.035 (−0.087 to 0.018; p = .16).

A post-hoc partial-scalar latent-variable analysis reproduced the direction of all three contrasts: T1−T0 = 0.43 (95% CI 0.31 to 0.55), T2−T0 = 0.23 (0.12 to 0.35), and T2−T1 = −0.20 (−0.32 to −0.07) on the standardised latent scale. The T2−T1 contrast was distinguishable from zero in this analysis (p = .002) but not in the primary observed-score model. Because scalar invariance was only partially supported, the latent estimates are secondary sensitivity results.

In a post-hoc exploratory analysis, attendance was positively associated with T0→T2 change (0.079 CDMSE points per additional session). The HC3 interval excluded zero (95% CI 0.020 to 0.139; p = .009), whereas the class-clustered CR2 interval did not (−0.003 to 0.162; p = .057); T0→T1 and T1→T2 slopes were also uncertain. Because attendance was not randomly assigned and the CR2 interval included zero, the association was treated as exploratory. Full model specifications and attendance diagnostics are in Additional file 1.

Secondary and interpretive outcomes

The five CDMSE domains showed heterogeneous patterns (Table 6). Information gathering had the largest immediate gain (T1−T0 d = 0.43); planning rose immediately (d = 0.31) but declined by T2 (T2−T1 d = −0.26); goal selection remained above baseline at T2 (d = 0.26); problem solving was also higher at T2 (d = 0.19); and self-appraisal changed little.

Career adaptability, assessed only at T0 and T1, rose from 3.39 (SD 0.62) to 3.58 (SD 0.58): T1−T0 = 0.171 (95% CI 0.118 to 0.224; d_baseline = 0.28; p < .001). CDMSE and adaptability were moderately correlated within each wave, whereas their T0→T1 changes were weakly related (r = .12, 95% CI −.03 to .27).

Course acceptability at T1 was moderately positive (Table 7). Item means ranged from 3.55 to 3.76 on a 5-point scale; disciplinary relevance was highest (M = 3.76; 68% choosing 4 or 5), and real-world actionability was lowest (M = 3.55; 53%).

At T2, 68.3% reported at least one preparation action (99/145; 95% CI 60.3–75.3). Item prevalences were 51.3% for self-directed exploration, 47.7% for CV or portfolio updating, 27.8% for competition, recruitment, internship, or practice, and 39.9% for a career conversation (Table 7). These single-wave self-reports had differing denominators and no baseline counterpart, so they describe prevalence rather than change.

Interview sample and qualitative findings

The 18 interviewees spanned all ten sampling-trajectory labels: returned-to-baseline-or-below (1), partial attenuation above T0 (3), recovery after initial decline (2), delayed improvement (1), immediate improvement then further increase (2), immediate improvement maintained

(2), late decrease (3), initial decrease maintained (1), persistent no reliable change (1), and continued decrease (2) (Table 8). Double-coding of the 60-unit reliability subsample (six transcripts) yielded 75.0% agreement and Cohen's κ = 0.74 (95% CI 0.63 to 0.85).

Framework analysis used a first-level deductive framework of the five career-decision task domains (self-appraisal, information gathering, goal selection, planning, and problem solving) and a second level of inductive themes; four themes are summarised below and mapped to the joint display (Table 9). Verbatim quotations are drawn from the de-identified transcripts and labelled by anonymised interview ID and sampling trajectory.

Theme 1 — Early clarity from profiling and information activities. Students most often located early change in the self-appraisal and information-gathering domains, describing the creative-career profile and the information-comparison tasks (E1–E2) as the point at which their competencies, portfolio, and available pathways became clearer. This theme was most common among "immediate-improvement" trajectories: one painting student described beginning to sort previously scattered information — "I began to distinguish university notices, recruitment platforms, and practitioners' experience, although information about personal style, exhibition routes, and portfolio narratives was still not entirely consistent" (INT001; immediate-improvement-maintained, painting).

Theme 2 — Maintenance versus erosion after the course. Accounts of the six-week window diverged. Several students described action plans stalling once course prompts and feedback ended and once coursework and portfolio deadlines competed for attention (codes: intention–action barrier, follow-up support need), consistent with the attenuation and return-to-baseline trajectories; a minority followed delayed-improvement or recovery-after-decline trajectories, in which renewed gains tended to follow an external project, competition, or client opportunity. One student described losing momentum after the course: "I was highly motivated immediately after the course, but assignments and projects later crowded some of that motivation out" (INT002; partial-attenuation-above-T0, visual communication design). A participant on a recovery-after-initial-decline trajectory described this sequence directly: "At first I became more confused because I realised the pathways were more complex than I had thought. Later, feedback on a project and a conversation with a practitioner helped me recover gradually" (INT003; recovery-after-initial-decline; programme detail suppressed).

Theme 3 — Discipline-specific conditions on turning plans into action. Portfolio and personal style, project-based and client work, freelance and income uncertainty, and AI-related changes in required skills recurred as conditions that students said shaped whether intentions became actions. The China–Korea joint-programme context added further considerations —

"What affected me most was project-based work, client communication, and implementation. Changes in AI tools also affect job requirements, but they are not the only factor" (INT012; China–Korea joint programme).

Theme 4 — Divergence between scores and narratives, and null cases. Some students whose scores rose reported no perceived overall change, and some with high baseline confidence or a prior career course reported little change. One participant explained: "There was no obvious difference before and after; I had encountered much of the content before. The course gave me an opportunity to organise my thinking, but it did not change my current choice" (INT004; persistent-no-reliable-change).

Mixed-methods integration

The joint display (Table 9) paired quantitative patterns with interview themes. Interview accounts contextualised the small T0→T1 mean rise by describing different starting points and course components. For the follow-up trajectories, participants described interrupted feedback, competing tasks, and external projects or client opportunities as perceived influences on maintenance or attenuation. Some scale trajectories diverged from students' narratives.

Discussion

Principal findings

In this prospective, single-group evaluation of routine teaching, career decision-making self-efficacy scores increased immediately and remained above baseline at six weeks. The standardised changes were small (about 0.27 immediately and 0.20 at follow-up). The immediate estimate was stable across sensitivity analyses, whereas the follow-up and T1→T2 estimates were more sensitive to attrition and measurement assumptions. Career adaptability rose modestly from baseline to the immediate assessment. Interviews contextualised the heterogeneous score trajectories and identified candidate course revisions.

The interviews placed individual context around the total-score estimates and showed heterogeneous paths beneath the group average. Students most often attributed early clarity to self-appraisal and information-comparison activities. During follow-up, they described attenuation in relation to the ending of course prompts and feedback and to competing coursework and portfolio deadlines, while continued gains were associated in their accounts with an external project or client opportunity.

Comparison with existing evidence

The direction of the findings — an immediate increase in career decision-making self-efficacy followed by partial attenuation over several weeks — was broadly consistent with a neighbouring Chinese quasi-experimental evaluation of a five-week career planning course [23] and with meta-analytic evidence that career interventions raise career decision-making self-efficacy [18]. However, the two studies differ in instrument (the 39-item scale [11] here versus a 25-item short form [24]), response anchors, population, follow-up window, and design. We therefore compare only the direction of construct-level change and the maintenance-versus-attenuation pattern, not raw means or effect sizes.

The domain-level analyses were exploratory. Information gathering showed the largest immediate increase ($d = 0.43$), goal selection remained above baseline at follow-up (T2−T0 $d = 0.26$), and planning confidence decreased between the immediate and follow-up assessments ($d = -0.26$). The pattern was compatible with the social-cognitive expectation that exploration-related confidence may change earlier than planning confidence and with the intention–behaviour gap between forming and enacting plans [39], and it identifies spaced reminders and follow-up feedback for evaluation.

A measurement-level competing explanation is response shift: a career course can change the internal standard, values, or meaning a student brings to items such as "how confident are you that you can gather occupational information," so part of the observed-score increase may reflect recalibration or reconceptualisation [40]. The failure of scalar invariance and the comparatively large information-gathering change are compatible with this explanation, but the design cannot distinguish response shift from change in the latent trait.

Art and design career context

Participants most often located early perceived change in portfolio-related self-appraisal and described freelance and income uncertainty, access to projects and clients, and AI-related changes in required skills as conditions shaping whether plans became actions. These accounts align with the non-standardised, portfolio- and project-based character of creative careers described for arts students and practitioners [1–3] and identify conditions to examine in comparisons of discipline-specific and generic provision.

Mixed-methods integration

The joint analysis showed that the small mean increase coexisted with heterogeneous starting points and occasional score–narrative discordance. Participants' accounts of interrupted

feedback and competing tasks identify candidate explanations for maintenance or attenuation in future evaluations.

Practical implications

Participants described plans stalling after prompts and feedback ended; real-world actionability was the lowest-rated acceptability item, and planning was the domain whose scores decreased between T1 and T2. These observations nominate spaced reminders and follow-up feedback for evaluation in the next course iteration. Profiling and information activities may be retained because students associated them with early clarity. Alumni and practitioner resources and longer or better-spaced dosing were the most frequently raised topics in the interview corpus (inductive codes I4 and I5: peer and alumni models, 31 coding units across all 18 interviews; course dose and pacing, 43 units in 17 of 18), whereas structured portfolio-feedback loops were more speculative. The effectiveness of any modification requires prospective evaluation.

Strengths and limitations

The study linked individual responses across three waves and integrated quantitative trajectories with interviews in a joint display. In routine teaching, this design connected average score changes with students' accounts of maintenance or attenuation and yielded candidate course refinements for controlled multi-site evaluation.

The study has four main limitations. First, without a control group, the observed change cannot be separated from first-semester development, concurrent activities, or repeat testing. Second, follow-up attrition favoured students with higher self-efficacy and attendance.

Third, evidence from one institution and 18 interviews is context-bound, and trajectory-informed probing may have increased confirmation risk. Fourth, career adaptability was not measured at T2, and preparation behaviour was self-reported at one wave. Consequently, maintenance of adaptability and change in preparation behaviour were outside the study's measurement scope.

Conclusions

Career decision-making self-efficacy scores increased from baseline to the immediate assessment and remained above baseline at six weeks; evidence for T1→T2 attenuation depended on the measurement model. Career adaptability increased from baseline to the immediate assessment. Trajectory-informed interviews described perceived influences on maintenance and attenuation and identified spaced reminders and follow-up feedback as

candidate modifications. Together, the longitudinal estimates and qualitative accounts identify priorities for controlled multi-site studies with longer follow-up and verified behavioural outcomes.

List of abbreviations

Abbreviation	Definition
CAAS-SF	Career Adapt-Abilities Scale–Short Form
CDMSE	career decision-making self-efficacy
COREQ	Consolidated criteria for Reporting Qualitative research
CR2	bias-reduced (type-2) cluster-robust standard errors
GRAMMS	Good Reporting of A Mixed Methods Study
HC3	heteroscedasticity-consistent (type-3) standard errors
ICC	intraclass correlation
IPW	inverse-probability weighting
LMM	linear mixed model
MAR	missing at random
MNAR	missing not at random
RCI	reliable change index
SD	standard deviation
SMD	standardised mean difference
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
TIDieR	Template for Intervention Description and Replication
TREND	Transparent Reporting of Evaluations with Nonrandomized Designs

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of North China University of Water Resources and Electric Power (Approval No. SFSNCWU20250905, 5 September 2025) and was conducted in accordance with the Declaration of Helsinki. All participants were adults (≥18 years at baseline) who provided written informed consent for the questionnaire and longitudinal-linkage study, with separate choices for follow-up contact, interview participation, audio recording, and the use of anonymised quotations. Research participation was voluntary and separate from routine course participation.

Consent for publication

All interviewees whose anonymised quotations appear in this article consented to their publication. No individual-identifying details are included.

Availability of data and materials

The data and supporting materials are available from the corresponding author on reasonable request. Because combinations of class, programme, and longitudinal responses may permit re-identification in this small set of intact classes, participant-level quantitative data are

available only in de-identified form under controlled access for research verification and non-commercial academic use, subject to ethics approval and a data-use agreement. The analysis plan, aggregate statistical outputs, analysis code, data and variable dictionaries, blank study-authored items, and course materials are also available from the corresponding author. Additional file 1 contains the aggregate materials supporting the reported results. Audio files and full interview transcripts are not available because they contain potentially identifiable contextual information.

Competing interests

The first author holds a position in the university's career/employment service. Role-separation procedures are described under Ethics and consent. The authors declare no other competing interests.

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Authors' contributions

Hang Mao: Conceptualization, Methodology, Formal analysis, Software, Writing – original draft. Jinyong Wu: Conceptualization, Supervision, Validation, Writing – review & editing. Longfei Feng: Data curation, Project administration, Writing – review & editing. All authors read and approved the final manuscript.

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Supplementary Information

Additional file 1. Contents: the sanitised source inventory; reporting-guideline applicability and checklist-completion summary (STROBE, TREND, COREQ, GRAMMS, and TIDieR); the pattern-mixture δ sensitivity grid; scale- and domain-level reliability and distribution summaries; aggregate course-fidelity, attendance, and deviation summaries; the operational qualitative codebook; trajectory reachability and interview-probe mapping; pooled inverse-probability-weighting diagnostics; a concise software and model-implementation summary; bilingual reported quotations; and aggregate item-correlation, candidate-frame, concurrent-activity, inductive-code, and measurement-invariance results. Item-level reliability output,

imputation-level diagnostics, participant-level attendance records, and the participant-by-theme matrix are available from the corresponding author under the controlled-access conditions stated above.

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Tables

Table 1. Course units mapped to CDMSE task domains and classroom outputs

Unit	Core content	Targeted CDMSE task(s)	Classroom output
Foundational module	Career-planning concepts; self, environment, decision, action; institutional resources; diversity of art & design pathways; course–research distinction	Foundation	—
E1 Creative career profile & ecology	Competencies, interests, values, portfolio; full-time / freelance / studio paths	Self-appraisal; information gathering	Career profile and ecology map
E2 Information exploration & path selection	Industries, roles, clients, platforms, income structures; path comparison	Information gathering; goal selection	Information-source table and decision matrix
E3 Career-experience day / carnival	Alumni and practitioner dialogue; real difficulties; case discussion	Goal selection; problem solving	Question list and situational solutions
E4 Creative career action lab	Goal breakdown; portfolio; CV; competitions; internships; contingency planning	Planning; problem solving	six-week action plan

CDMSE, career decision-making self-efficacy. The foundational module preceded sessions E1–E4; a career-experience day was embedded in E3.

Table 2. Participant characteristics (consented sample) and attrition comparison

Panel A. Percentages for binary items computed on non-missing responses.

Characteristic	Value (N = 210)
Age, years, M (SD)	18.81 (1.03)
Female	146 (69.5%)
Male	50 (23.8%)
Prefer not to say / self-described	14 (6.7%)
China–Korea joint programme	56/210 (26.7%)
Prior systematic career course	46/207 (22.2%)
Prior internship or part-time	72/206 (35.0%)
Prior career/entrepreneurship competition	61/207 (29.5%)
Existing portfolio	98/208 (47.1%)
Considered self-employment/freelance	83/207 (40.1%)

Panel B. Consented participants by class.

Class	Programme	Consented N
PNT01	Painting	21
ENV01	Environmental design	27
ENV02	Environmental design	27
VIS01	Visual communication design	29
VIS02	Visual communication design	26
PUB01	Public art	24
SKENV01	Environmental design (China–Korea)	28
SKENV02	Environmental design (China–Korea)	28

Panel C. Standardised mean differences (SMD), T2 completers vs non-completers; $|\mathrm{SMD}| \geqslant 0.20$ flags a difference worth noting and is not a baseline-balance significance test.

Variable	T2 completers	T2 non-completers	SMD
Baseline CDMSE	3.31	3.03	+0.62
Baseline CAAS	3.45	3.23	+0.36
Attendance count	3.79	3.39	+0.39
Observed T1 CDMSE	3.44	3.17	+0.56
Prior systematic career course	20.4%	27.3%	-0.16
Prior practical experience	32.7%	41.5%	-0.18
Valid T1 completion	88.3%	76.8%	+0.31

Table 3. Course implementation and fidelity by class

Class	Sessions	Mean cov %	Min cov %	Mean min	Major dev.	Resched.	Tech/venue	Attend. %
ENV01	5	93.8	90.6	87.8	0	0	2	74.1
ENV02	5	82.0	72.0	96.6	1	1	2	75.6
PNT01	5	87.4	75.3	89.2	1	1	1	75.2
PUB01	5	86.8	77.2	86.6	1	0	1	72.5
SKENV01	5	84.0	74.8	80.0	2	1	1	72.9
SKENV02	5	91.9	88.4	92.6	0	0	1	72.9
VIS01	5	88.3	82.0	96.0	0	0	0	80.0
VIS02	5	79.4	74.0	84.4	2	1	3	65.4

Across the eight classes, seven major deviations, four rescheduling or make-up sessions, and 11 technical or venue problems were recorded, alongside absence, partial-attendance, and approved-leave entries; mean core-content coverage ranged from 79.4% to 93.8% and attendance from 65.4% to 80.0%. Concurrent institution-wide activities during the study window included AI-industry lectures, alumni talks, a recruitment fair, and a university-level career carnival on 13–14 November (within the T1–T2 window); a university-wide career-experience event followed T2 (16–18 December).

Table 4. Internal consistency, item properties, and descriptive statistics by wave

Scale / dimension	Wave	N	Mean	SD	α	ω	Mean inter-item r	Floor %	Ceiling %
CDMSE-39 total	T0	198	3.24	0.48	0.895	0.898	0.183	0.00	0.00
Self-appraisal	T0	198	3.46	0.59	0.570	0.574	0.183	—	—
Information gathering	T0	198	3.20	0.59	0.734	0.741	0.239	—	—
Goal selection	T0	197	3.23	0.62	0.750	0.754	0.252	—	—
Planning	T0	198	3.16	0.63	0.710	0.716	0.237	—	—
Problem solving	T0	198	3.18	0.61	0.596	0.607	0.177	—	—
CDMSE-39 total	T1	179	3.38	0.49	0.900	0.902	0.189	0.00	0.00
Self-appraisal	T1	179	3.56	0.63	0.622	0.628	0.217	—	—
Information gathering	T1	179	3.47	0.64	0.785	0.788	0.290	—	—
Goal selection	T1	179	3.31	0.62	0.751	0.758	0.253	—	—
Planning	T1	179	3.36	0.59	0.666	0.674	0.202	—	—
Problem solving	T1	179	3.21	0.55	0.533	0.567	0.142	—	—
CDMSE-39 total	T2	154	3.40	0.45	0.877	0.880	0.157	0.00	0.00
Self-appraisal	T2	154	3.56	0.63	0.649	0.652	0.239	—	—
Information gathering	T2	154	3.43	0.60	0.722	0.737	0.229	—	—
Goal selection	T2	154	3.48	0.57	0.714	0.722	0.219	—	—
Planning	T2	154	3.23	0.61	0.689	0.699	0.222	—	—
Problem solving	T2	154	3.35	0.58	0.547	0.560	0.150	—	—
CAAS-SF total	T0	198	3.39	0.62	0.815	0.817	0.269	0.00	0.00
Concern	T0	196	3.34	0.78	0.581	0.596	0.315	—	—
Control	T0	198	3.50	0.82	0.685	0.688	0.420	—	—
Curiosity	T0	192	3.28	0.81	0.591	0.605	0.321	—	—
Confidence	T0	194	3.43	0.80	0.571	0.576	0.304	—	—
CAAS-SF total	T1	179	3.58	0.58	0.801	0.804	0.252	0.00	0.00
Concern	T1	177	3.42	0.76	0.497	0.531	0.251	—	—
Control	T1	178	3.74	0.83	0.717	0.724	0.461	—	—
Curiosity	T1	178	3.54	0.82	0.713	0.713	0.450	—	—
Confidence	T1	174	3.60	0.70	0.494	0.499	0.246	—	—

α, Cronbach's alpha; ω, McDonald's omega (single-factor approximation). Floor/ceiling are shown for the total scales only. Scores are the mean of available items (person-mean proration), so a per-domain N may differ slightly from the total-scale N while the mixed models used the same analysis sample. CDMSE-39 total is the single primary indicator; domains and CAAS dimensions are interpretive/exploratory. CAAS-SF at T0 and T1 only.

Table 5. Primary and sensitivity analyses for the CDMSE-39 total-scale mean

Analysis	Contrast	Estimate	95% CI	d	p
Primary LMM	T1−T0	0.130	[0.082, 0.178]	0.27	<.001

Primary LMM	T2−T0	0.095	[0.045, 0.146]	0.20	<.001
Primary LMM	T2−T1	-0.035	[-0.086, 0.017]	-0.07	0.191
Sensitivity: no covariates	T1−T0	0.127	[0.079, 0.174]	0.26	<.001
Sensitivity: no covariates	T2−T0	0.098	[0.047, 0.148]	0.20	<.001
Sensitivity: no covariates	T2−T1	-0.029	[-0.081, 0.022]	-0.06	0.264
Sensitivity: complete cases	T1−T0	0.114	[0.059, 0.170]	0.24	<.001
Sensitivity: complete cases	T2−T0	0.059	[0.003, 0.114]	0.12	0.038
Sensitivity: complete cases	T2−T1	-0.056	[-0.111, -0.001]	-0.12	0.048
Sensitivity: excl. baseline-flagged (post-hoc)	T1−T0	0.119	[0.071, 0.168]	0.25	<.001
Sensitivity: excl. baseline-flagged (post-hoc)	T2−T0	0.091	[0.040, 0.142]	0.19	<.001
Sensitivity: excl. baseline-flagged (post-hoc)	T2−T1	-0.029	[-0.081, 0.024]	-0.06	0.283
IPW (trimmed)	T1−T0	0.129	[0.062, 0.196]	—	<.001
IPW (trimmed)	T2−T0	0.079	[0.014, 0.143]	—	0.017
IPW (trimmed)	T2−T1	-0.050	[-0.111, 0.010]	—	0.101
CR2 (8 clusters)	T1−T0	0.130	[0.063, 0.196]	—	0.003
CR2 (8 clusters)	T2−T0	0.095	[0.027, 0.163]	—	0.013
CR2 (8 clusters)	T2−T1	-0.035	[-0.087, 0.018]	—	0.163

LMM with time categorical (T0 reference), class fixed effects, and participant random intercept; d = estimate ÷ SD(T0 observed). IPW, stabilised inverse-probability-of-response weighting (50 imputations); CR2, cluster-robust SE clustered on class (8 clusters; Satterthwaite df ≈ 6.9). Across the pre-specified pattern-mixture range (−0.20 to +0.20 × SD[T0]), T1−T0 and T2−T0 remained positive with intervals excluding zero. The extended grid and diagnostics are in Additional file 1. The out-of-window analysis matched the primary model because no responses fell outside the assessment windows.

Table 6. Secondary and interpretive outcomes: CDMSE domains and career adaptability

Panel A. CDMSE domain contrasts (interpretive).

Domain	Contrast	Estimate	95% CI	d	p
Self-appraisal	T1−T0	0.075	[-0.011, 0.160]	0.13	0.088
Self-appraisal	T2−T0	0.030	[-0.059, 0.120]	0.05	0.508
Self-appraisal	T2−T1	-0.044	[-0.136, 0.048]	-0.07	0.346
Information gathering	T1−T0	0.253	[0.177, 0.329]	0.43	<.001
Information gathering	T2−T0	0.154	[0.075, 0.234]	0.26	<.001
Information gathering	T2−T1	-0.098	[-0.180, -0.017]	-0.17	0.018
Goal selection	T1−T0	0.082	[0.008, 0.157]	0.13	0.031
Goal selection	T2−T0	0.162	[0.084, 0.240]	0.26	<.001
Goal selection	T2−T1	0.080	[-0.000, 0.160]	0.13	0.051
Planning	T1−T0	0.197	[0.114, 0.281]	0.31	<.001
Planning	T2−T0	0.033	[-0.055, 0.121]	0.05	0.461
Planning	T2−T1	-0.164	[-0.254, -0.074]	-0.26	<.001
Problem solving	T1−T0	0.015	[-0.069, 0.099]	0.02	0.730
Problem solving	T2−T0	0.116	[0.028, 0.204]	0.19	0.009
Problem solving	T2−T1	0.101	[0.011, 0.192]	0.17	0.027

Panel B. Career adaptability (secondary; T0→T1 only).

Outcome	Contrast	Estimate	95% CI	d	p
CAAS-SF total	T1−T0	0.171	[0.118, 0.224]	0.28	<.001

Each domain model, like the total-scale model, was fitted on the same 203 participants (516 observations for the total scale; the goal-selection domain model used 515, reflecting one item-level missing case). Because these are separate mixed models with their own variance components, the domain estimates need not sum to the total.

Table 7. Course acceptability and self-reported preparation behaviour

Panel A. Course acceptability at T1 (5-point items).

Item	N	M (SD)	% choosing 4 or 5
Disciplinary relevance	182	3.76 (0.69)	68.1%
Understanding of pathways	180	3.71 (0.80)	63.9%
Clarity of instructions	182	3.74 (0.73)	61.5%
Real-world actionability	182	3.55 (0.71)	52.7%
Willingness to recommend	182	3.63 (0.78)	57.7%
Overall satisfaction	182	3.60 (0.73)	55.5%

Panel B. Self-reported preparation behaviour at T2 (per-item denominators).

Self-reported behaviour	n / N	%	95% CI
Updated CV or portfolio	72 / 151	47.7%	[39.9, 55.6]
Competition / recruitment / internship / practice	42 / 151	27.8%	[21.3, 35.4]
Career conversation	61 / 153	39.9%	[32.5, 47.8]
Self-directed exploration	78 / 152	51.3%	[43.4, 59.1]
Any preparation behaviour	99 / 145	68.3%	[60.3, 75.3]

Acceptability items rated 1–5 at T1 (per-item N 180–182; two respondents skipped the pathways item); endorsement = % choosing 4 or 5. T2 behaviours are single-wave self-reports (prevalence only); denominators differ because non-responses were not coded as absent. Behaviour 95% CIs are Wilson score intervals.

Table 8. Interview sampling trajectories: candidates and interviewees

Sampling trajectory	Trajectory-classifiable (three-wave)	Interviewed
Returned to T0 or below	21	1
Immediate improvement, maintained	17	2
Recovery after initial decline	17	2
Immediate improvement, then increase	16	2
Late decrease	14	3
Delayed improvement	13	1
Partial attenuation, above T0	13	3
Continued decrease	9	2
Initial decrease, maintained	4	1
Persistent no reliable change	4	1
Total	128	18

"Trajectory-classifiable" counts students with valid data at all three waves; interview invitations were drawn from the eligible frame of 83 (three-wave-classifiable ∩ contact-consent). Twenty-one were invited and 18 interviewed (2 declined, 1 no response). Per-trajectory counts within the 83-participant eligible frame are in Additional file 1 (cells < 5 suppressed for anonymity).

Table 9. Joint display of quantitative findings and qualitative themes

Quantitative finding	Estimate / pattern	Qualitative theme	Relationship	Integrated interpretation	Course recommendation
Small T0→T1 rise in CDMSE	Est. = 0.130	Students attributed clarity to profiling and information comparison	Complementarity	Interview accounts contextualise variation in starting points and course components	Evaluate contextual profiling tasks and layered entry points in a future iteration
T2 above T0 but below T1	T2−T0 = 0.095; T2−T1 = −0.035	Perceived interruption of feedback and competing tasks	Complementarity	Participants linked individual trajectories to interrupted feedback and competing tasks; the group-level T1→T2 change	Test spaced reminders and follow-up feedback in a future evaluation

				remains uncertain	
Some scale trajectories differ from narratives	Rise without perceived overall change in some cases	Scale spans several domains; students foreground one	Discordance	The source of the score–narrative divergence remains unresolved	Keep neutral probing; do not require reconciliation

Relationship types follow mixed-methods integration; Table 9 contains complementarity and discordance.

Figure legends

Figure 1. Participant flow (STROBE). Students enrolled, eligible, consented, and providing valid CDMSE data at each wave, with exclusions, missingness patterns, analysis populations, and the interview branch. Waves are not strictly nested; wave counts reflect new and intermittent (non-monotone) missingness.

Figure 2. Career decision-making self-efficacy (CDMSE-39) across three waves. Unadjusted observed means (solid line) were 3.235, 3.378, and 3.404; model-estimated marginal means (dashed line) were 3.243, 3.372, and 3.338. Contrasts calculated from unrounded model estimates were T1−T0 = 0.130, T2−T0 = 0.095, and T2−T1 = −0.035; apparent 0.001 differences from subtracting the displayed means are due to rounding. Error bars are descriptive 95% CIs for observed means and model-based 95% CIs for marginal means, not CIs for the contrasts. The observed T2 mean exceeded the model estimate; T2 completers had higher self-efficacy (n = 154). The y-axis is truncated.

Figures

Figure 1

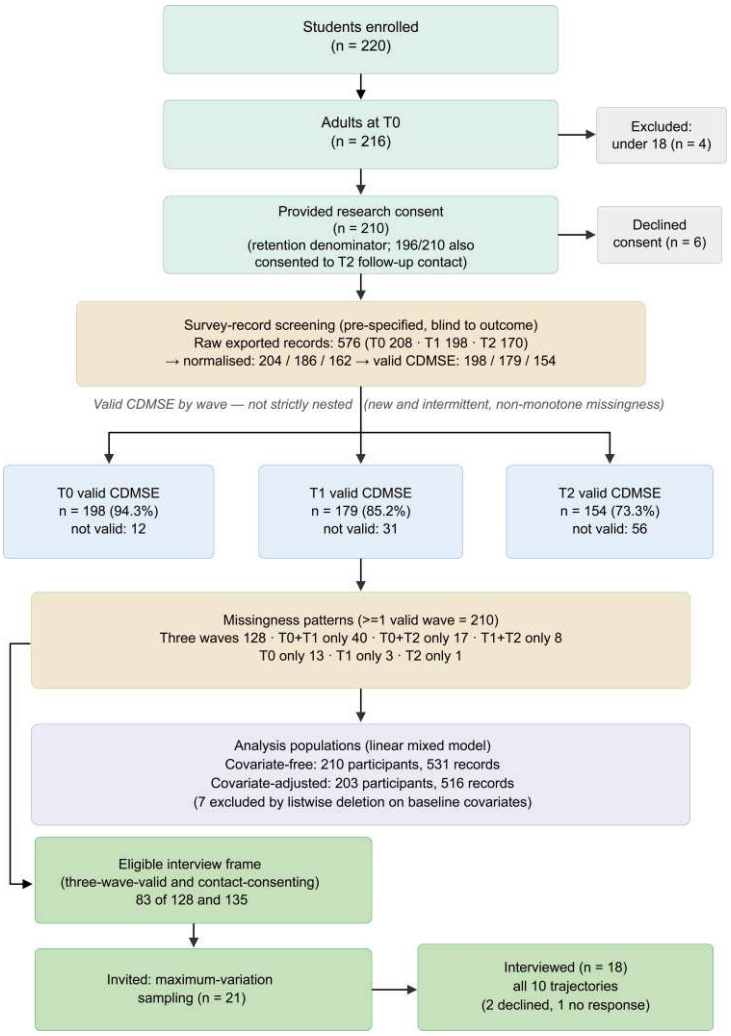
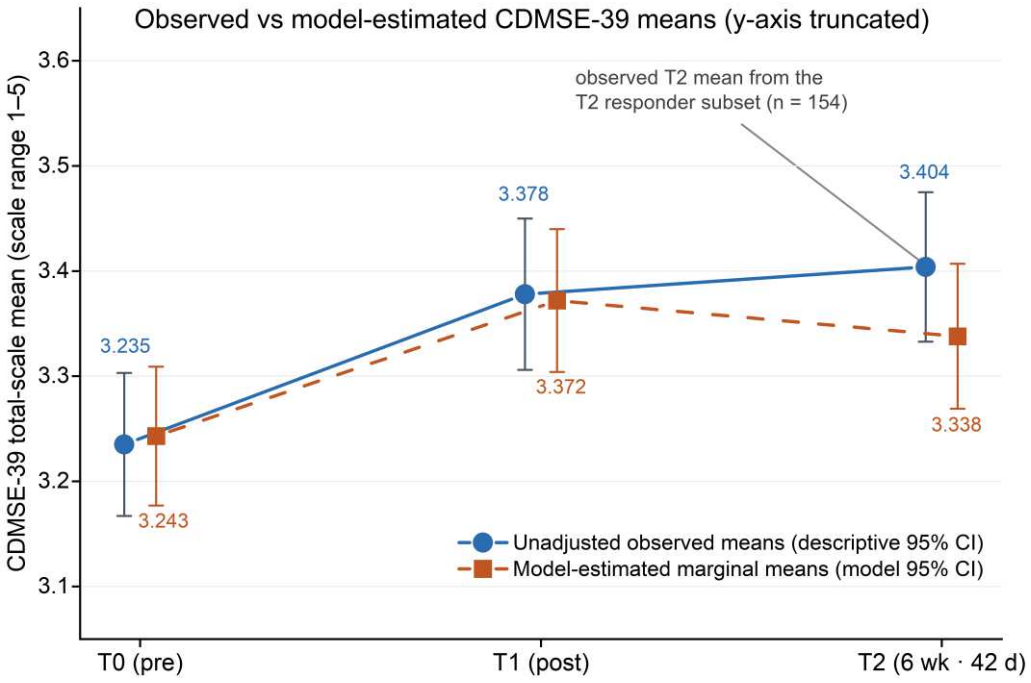

Students enrolled
(n = 220)
Adults at T0
(n = 216)
Excluded:
under 18 (n = 4)
Provided research consent
(n = 210)
(retention denominator; 196/210 also
consented to T2 follow-up contact)
Declined
consent (n = 6)
Survey-record screening (pre-specified, blind to outcome)
Raw exported records: 576 (T0 208 · T1 198 · T2 170)
→ normalised: 204 / 186 / 162 → valid CDMSE: 198 / 179 / 154
Valid CDMSE by wave — not strictly nested (new and intermittent, non-monotone missingness)
T0 valid CDMSE
n = 198 (94.3%)
not valid: 12
T1 valid CDMSE
n = 179 (85.2%)
not valid: 31
T2 valid CDMSE
n = 154 (73.3%)
not valid: 56
Missingness patterns (>=1 valid wave = 210)
Three waves 128 · T0+T1 only 40 · T0+T2 only 17 · T1+T2 only 8
T0 only 13 · T1 only 3 · T2 only 1
Analysis populations (linear mixed model)
Covariate-free: 210 participants, 531 records
Covariate-adjusted: 203 participants, 516 records
(7 excluded by listwise deletion on baseline covariates)
Eligible interview frame
(three-wave-valid and contact-consenting)
83 of 128 and 135
Invited: maximum-variation
sampling (n = 21)
Interviewed (n = 18)
all 10 trajectories
(2 declined, 1 no response)

Figure 2


Observed vs model-estimated CDMSE-39 means (y-axis truncated)
CDMSE-39 total-scale mean (scale range 1–5)
3.6
3.5
3.4
3.3
3.2
3.1
observed T2 mean from the
T2 responder subset (n = 154)
3.404
3.378
3.235
3.372
3.338
3.243
Unadjusted observed means (descriptive 95% CI)
Model-estimated marginal means (model 95% CI)
T0 (pre)
T1 (post)
T2 (6 wk · 42 d)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile.docx