



When a Statistical Sequence Is Not a Developmental Sequence: A Theory-First Workflow for Process Model 6 in Educational Research

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ABSTRACT

Serial mediation is frequently selected from a statistical template before the ordering of mediators has been adequately justified. This methodological article develops a theory-first workflow for applying Hayes PROCESS Macro Model 6 in educational research and demonstrates the workflow using data from 400 novice public secondary-school teachers in five districts of Selangor, Malaysia. The novice-teacher dataset is used as a worked methodological illustration rather than as the article's primary substantive contribution. Mentoring was specified as the predictor (X), psychological capital as the first mediator (M1), work engagement as the second mediator (M2), and professional identity as the outcome (Y). The analysis used 5,000 bootstrap resamples and 95% confidence intervals. Mentoring was positively associated with psychological capital and work engagement, while psychological capital and work engagement were each positively associated with professional identity conditional on the other variables in the corresponding regression equations. All three specific indirect effects excluded zero: through psychological capital (0.17, 95% CI [0.14, 0.21]), through work engagement (0.13, 95% CI [0.10, 0.17]), and serially through psychological capital and work engagement (0.03, 95% CI [0.02, 0.05]). The remaining direct association between mentoring and professional identity was not statistically significant after accounting for the mediators. The example shows how Model 6 decomposes an overall association into substantively distinct routes, while demonstrating that a statistical sequence does not establish developmental succession. Bootstrap inference quantifies uncertainty in indirect-effect products; it does not establish temporal precedence, eliminate omitted-variable bias, validate measurement, or identify causal mediation effects. Researchers should therefore justify mediator order before estimation, report every constituent path and specific indirect effect, examine credible rival sequences, and reserve causal language for designs that support causal identification and temporal ordering.

Keywords: PROCESS Macro, serial mediation, novice teachers, psychological capital, professional identity

INTRODUCTION

Educational research increasingly asks not only whether variables are related but how a theoretically proposed process may connect them. This shift is consequential in novice-teacher research. A positive correlation between mentoring and professional identity establishes covariation, yet it does not specify what mentoring helps a beginning teacher acquire or enact. A mechanism-oriented account requires intermediate variables and a defensible order among them. Serial mediation is one statistical representation of such an account. Recent longitudinal evidence shows that beginning teachers' professional identity can change substantially during the first year and that school resources and emotional demands help explain those changes (Li et al., 2022). Early-career research likewise portrays identity as a negotiated configuration of values and tensions rather than a fixed attribute (Nickel & Crosby, 2022; Weiß et al., 2023).

PROCESS Macro Model 6 is frequently described as a convenient procedure for testing two or more mediators in sequence. Convenience, however, is not a sufficient methodological rationale. Hayes and Rockwood (2020) define indirect effects as products of constituent regression paths and distinguish parallel, serial, and blended multiple-mediator structures. Their treatment implies that the analyst must first decide which causal or

developmental story is being represented, then specify the equations and interpret the estimates within the limits of the research design. The model number is therefore secondary to the substantive theory encoded by the arrows.

This article argues that a defensible application of Model 6 requires a sequence of linked methodological decisions rather than selection of a software template. The Malaysian novice-teacher dataset is used solely as a worked methodological illustration, not as the primary substantive contribution of the article. Its purpose is to demonstrate how an ordered mediation hypothesis can be translated into regression equations, estimated transparently, scrutinized against rival sequences, and interpreted within the evidential limits of cross-sectional data. The central contribution is therefore the theory-first workflow itself rather than a claim that the worked example establishes how professional identity develops.

The article first explains when Model 6 is appropriate and how it differs from parallel mediation. It then maps the novice-teacher constructs to the statistical template, walks through the constituent regression equations, interprets the direct, total, and specific indirect effects, examines rival explanations, and closes with reporting and design cautions. The objective is not to treat PROCESS as a device that discovers mechanisms automatically. It is to show how the macro can implement and discipline a mechanism already specified by theory.

The Methodological Problem and Contribution

The accessibility of PROCESS has reduced the computational barrier to mediation analysis, but it has also made template-driven modelling easy. An analyst can enter two mediators, request Model 6, and obtain a table of indirect effects without explaining why one mediator precedes the other, which alternative sequences were plausible, or what the timing of measurement permits. This creates a mismatch between the apparent directionality of a path diagram and the evidential content of a cross-sectional design. Arrows can encode a hypothesis; they do not transform simultaneous measurements into observations of change.

Existing methodological work explains the mathematics of mediation and conditional process analysis in considerable depth (Hayes & Rockwood, 2017, 2020; Preacher & Hayes, 2008). The recurring applied problem in education is translation: researchers must connect developmental theory to a model template, interpret several overlapping indirect routes, and resist causal language when the design is not temporally informative. This article contributes a compact eight-stage workflow for that translation: define the mechanism, justify mediator order, specify the equations, check measurement and assumptions, estimate specific indirect effects, examine rival sequences, calibrate claims to design, and plan stronger temporal validation.

The worked example is analytically useful because professional development is inherently temporal while the available data are cross-sectional. It therefore exposes rather than conceals the central tension. A resource-to-engagement-to-identity sequence is substantively coherent, yet its temporal interpretation remains provisional. The example demonstrates how an educational researcher can extract methodological value from Model 6 without presenting the output as proof of a developmental chain.



Figure 1. Theory-First Workflow for PROCESS Model 6

What Question Does Model 6 Answer?

From Association to an Ordered Mechanism

A mediation model represents the proposition that the association between X and Y is transmitted, in whole or in part, through an intervening variable. With two mediators, the mediators may operate in parallel or in series. A parallel model proposes that X is associated with M1 and M2 independently and that each mediator is associated with Y. A serial model adds an ordered link from M1 to M2. The serial specification therefore represents a stronger substantive claim: the process represented by M1 is expected to precede or enable the process represented by M2.

For two serial mediators, Model 6 estimates three specific indirect effects. The first passes through M1 only; the second passes through M2 only; and the third passes through M1 and M2 in sequence. Hayes and Rockwood (2020) emphasize that each is a product of the regression coefficients constituting that pathway. The serial indirect effect is not a special significance test for a chain. It is the estimated product $a_1d_2b_2$, accompanied by an interval representing its sampling uncertainty.

Table 1. Translating the substantive model into PROCESS Model 6

Role	Study construct	Substantive function
X	Mentoring functions	Contextual resource: career and psychosocial support
M1	Psychological capital	Personal resource: efficacy, hope, resilience, optimism
M2	Work engagement	Motivational enactment: vigor, dedication, absorption
Y	Professional identity	Theoretically proposed developmental outcome: identification with teaching

The order M1 then M2 was selected because mentoring is located in the work context, psychological capital represents a resource that may be strengthened through social support, and engagement expresses the investment of that resource in professional activity. The reverse order is statistically estimable but theoretically different. PROCESS cannot decide which order is true; changing the mediator order changes the model being tested. This ordering is consistent with recent teacher research showing positive associations between psychological capital and work engagement (Ma, 2023; Xu, 2023) and an indirect role for work engagement in connecting psychological capital with occupational outcomes (Guo et al., 2022). Evidence that mentor relationships are associated with novice teachers' professional commitment, and that mentoring approaches shape emerging teacher identity, further supports treating mentoring as a contextual resource rather than a purely administrative arrangement (Prabjandee, 2022; Vaitzman Ben-David & Berkovich, 2021).

The Worked Example

Design, Participants, and Measures

The illustrative data came from a quantitative cross-sectional survey conducted in 2022. The participants were 400 novice teachers with one to five years of service in public secondary schools across Petaling Perdana, Petaling Utama, Hulu Langat, Sepang, and Kuala Langat in Selangor. All focal constructs were measured with five-point Likert-type response scales ranging from 1 (strongly disagree) to 5 (strongly agree), with higher composite scores indicating higher levels of the construct. Professional identity was measured using an adapted combination of the Teacher Professional Identity instrument by Karaolis and Philippou (2019) and the Teacher Identity Measurement Scale by Hanna et al. (2020). The instrument entered the pilot study with 65 items across seven dimensions: motivation, self-image, self-esteem, self-efficacy, task perception, future perspective, and professional commitment. Exploratory factor analysis (EFA) removed three items with loadings below .60, yielding a 62-item final measure ($\alpha = .843$). Psychological capital was assessed using the 24-item

Psychological Capital Questionnaire (PCQ) based on Luthans, Youssef, and Avolio (2007) and Luthans, Youssef-Morgan, and Avolio (2015), covering self-efficacy, hope, resilience, and optimism ($\alpha = .849$). Work engagement was assessed using the Utrecht Work Engagement Scale (UWES) by Schaufeli and Bakker (2003). The 17-item version represented vigor, dedication, and absorption; one item was removed after EFA, leaving 16 items ($\alpha = .861$). Mentoring was assessed using a 16-item measure of mentor functions adapted from Chang and Busser (2017) for the novice-teacher context, representing career-development and psychosocial-support functions ($\alpha = .906$).

Measurement adaptation and construct-validity checks preceded the main analysis. Face and content validity were evaluated by five experts. The overall content validity index (CVI) was .99 for professional identity, .98 for psychological capital, .98 for work engagement, and 1.00 for mentoring. A pilot study with 150 novice teachers in Melaka was then used for exploratory dimension reduction using principal component analysis with Varimax rotation. Sampling adequacy and factorability were supported for professional identity (KMO = .821; Bartlett's chi-square = 8193.237, $df = 2080$, $p < .001$), psychological capital (KMO = .882; Bartlett's chi-square = 2406.727, $df = 276$, $p < .001$), work engagement (KMO = .897; Bartlett's chi-square = 1599.528, $df = 136$, $p < .001$), and mentoring (KMO = .844; Bartlett's chi-square = 2873.719, $df = 120$, $p < .001$). The retained solutions accounted for 66.249%, 66.076%, 68.331%, and 77.812% of variance, respectively. The resulting component structure supported seven professional-identity components, four psychological-capital components, three work-engagement components, and two mentoring components. Confirmatory factor analysis was not conducted; consequently, the measurement evidence in this study should be interpreted as exploratory rather than confirmatory. This distinction is important because internal consistency alone does not establish construct validity.

The constructs were strongly and positively related. Professional identity correlated with psychological capital at $r = .822$, work engagement at $r = .754$, and mentoring at $r = .613$. These relationships make mediation plausible but do not establish a causal process. Correlation screening is not a prerequisite test that proves mediation; rather, it describes the empirical context in which the theoretically specified indirect effects are estimated.

Model Specification

The analysis specified mentoring as X, psychological capital as M1, work engagement as M2, and professional identity as Y. The original analysis was conducted in IBM SPSS Statistics Version 26 using Hayes' PROCESS Macro for SPSS Version 4.2. Model 6 was estimated with 5,000 bootstrap resamples and 95% confidence intervals. Unstandardized coefficients were retained because indirect effects are computed from products of coefficients across equations. The conceptual chain was mentoring $\rightarrow$ psychological capital $\rightarrow$ work engagement $\rightarrow$ professional identity.

In PROCESS syntax, the essential specification for the worked example is: PROCESS vars = MNTOR MPSI PKRJA IDPROF /y = IDPROF /x = MNTOR /m = MPSI PKRJA /model = 6 /boot = 5000 /total = 1. The order after /m is consequential: MPSI is M1 and PKRJA is M2. Covariates, if justified before analysis, should be added consistently to the equations rather than selected solely because they alter statistical significance.

Missing-data handling. The regression diagnostics used listwise handling. All four focal variables contained 400 valid observations in the analytic dataset, and the PROCESS Model 6 output likewise reported a sample size of 400. No case was therefore lost from the focal Model 6 analysis because of missing values on mentoring, psychological capital, work engagement, or professional identity.

Assumptions Before Estimation

Model 6 inherits the assumptions of the regression equations used to estimate its paths. Accordingly, linearity, influential observations, residual behaviour, homoscedasticity, and collinearity should be examined for each constituent equation rather than for Model 6 as a single omnibus object. This requirement is especially important in the present illustration because psychological capital and professional identity were strongly correlated ($r = .822$). Strong bivariate associations may be theoretically expected, but they can also increase coefficient instability and heighten concerns about construct overlap. Reporting only scale reliability and bivariate

correlations is therefore insufficient for a reproducible methodological demonstration (Cole & Preacher, 2014; Schuler et al., 2025).

Regression diagnostics. For the professional identity equation, tolerance values were .371 for mentoring, .603 for psychological capital, and .293 for work engagement, with corresponding VIF values of 2.694, 1.658, and 3.410. For the work engagement equation, tolerance was .764 and VIF was 1.309 for both mentoring and psychological capital. These values did not indicate severe multicollinearity. Influence diagnostics likewise identified no highly influential observations: the maximum Cook's distance was .011 for the professional identity and work engagement equations and .009 for the psychological capital equation. Standardized and studentized residuals remained within approximately plus or minus 2 across the three equations. Visual inspection of residual histograms, normal probability plots, and standardized residual versus predicted value plots did not reveal an extreme pattern that would preclude interpretation of the constituent regressions. These checks are treated as regression diagnostics rather than as proof that every distributional assumption is perfectly satisfied. The model also assumes that the variables have been scored in a substantively defensible way. Composite scores suppress item-level measurement error and presume that the scale structure established elsewhere is adequate in the current population. In an applied regression workflow, this limitation should be made visible through reliability evidence, transparent scoring rules, and, where possible, prior confirmatory measurement analysis. The bootstrap addresses the distribution of the coefficient products; it does not address construct validity or measurement invariance. Finally, covariates require causal and substantive justification. Adding demographic variables mechanically can alter the estimand and introduce bias when a covariate is a consequence of X or shares causes with a mediator and outcome. A rigorous methodological report should explain why each covariate belongs in each equation and whether conclusions change under a prespecified alternative specification. The present worked example emphasizes the unadjusted focal path system because no defensible covariate set was established for this methodological illustration.

Measurement And Common-Source Considerations

All four focal constructs were collected from the same respondents, at the same measurement occasion, using self-report Likert-type instruments. This common-source structure creates a plausible risk that shared response tendencies or method variance may contribute to covariance among the observed composite scores. Such bias is particularly relevant in mediation because inflation of several constituent associations can propagate into an indirect-effect product. The present analysis therefore treats the PROCESS estimates as associations among observed composite scores rather than as evidence that the latent constructs are perfectly distinct or free from common-method influence. Measurement validation should ideally precede structural interpretation, and latent-variable approaches are preferable when explicit correction for measurement error is central to the research question (Cole & Preacher, 2014; Podsakoff et al., 2003).

The Regression Journey Through Model 6

Equation 1: Estimating the First Resource Path

The first equation regresses psychological capital on mentoring: $M1 = i1 + a1X + e1$. Coefficient $a1$ estimates the expected difference in psychological capital associated with a one-unit difference in mentoring. In the worked example, mentoring was positively associated with psychological capital, $B = 0.45$, $SE = 0.04$, $t = 11.09$, $p < .001$, 95% CI [0.37, 0.53]. This coefficient supplies the first component of both the M1-only indirect effect and the serial indirect effect.

Equation 2: Estimating the Link Between Mediators

The second equation regresses work engagement on mentoring and psychological capital: $M2 = i2 + a2X + d21M1 + e2$. The coefficient $d21$ is central to the serial proposition because it estimates the association between M1 and M2 while controlling for X. Psychological capital was positively associated with work engagement conditional on mentoring, $B = 0.34$, $SE = 0.03$, $t = 10.29$, $p < .001$, 95% CI [0.28, 0.41]. Mentoring also retained a positive association with work engagement conditional on psychological capital, $B = 0.63$, $SE = 0.03$, $t = 20.49$, $p < .001$, 95% CI [0.57, 0.69].

Equation 3: Estimating the Outcome Model

The third equation regresses professional identity on mentoring, psychological capital, and work engagement: $Y = i3 + c\text{-prime} X + b1M1 + b2M2 + e3$. Psychological capital was positively associated with professional identity conditional on mentoring and work engagement, $B = 0.38$, $SE = 0.02$, $t = 18.57$, $p < .001$, 95% CI [0.34, 0.42], and work engagement was also positively associated with professional identity conditional on mentoring and psychological capital, $B = 0.21$, $SE = 0.03$, $t = 7.70$, $p < .001$, 95% CI [0.16, 0.27]. The remaining direct association of mentoring was $B = 0.04$, $SE = 0.02$, $t = 1.53$, $p = .13$, 95% CI [-0.01, 0.08].

Table 2. Constituent regression paths in the illustrative Model 6 analysis

Path	B	SE	t	p	95% CI
X -> M1	0.45	0.04	11.09	< .001	[0.37, 0.53]
M1 -> M2	0.34	0.03	10.29	< .001	[0.28, 0.41]
X -> M2	0.63	0.03	20.49	< .001	[0.57, 0.69]
M1 -> Y	0.38	0.02	18.57	< .001	[0.34, 0.42]
M2 -> Y	0.21	0.03	7.70	< .001	[0.16, 0.27]
X -> Y (direct)	0.04	0.02	1.53	.13	[-0.01, 0.08]

From Paths To Indirect Effects

Why Bootstrap the Products?

An indirect effect is a product of regression coefficients. Product terms generally have asymmetric sampling distributions, especially in finite samples, so normal-theory tests are poorly matched to the quantity being estimated. Resampling approximates the empirical sampling distribution by repeatedly drawing samples with replacement, estimating the model in each sample, and retaining the resulting products. The percentile boundaries of these products form a bootstrap confidence interval. Consistent with Hayes and Rockwood (2020), an indirect effect is statistically distinguishable from zero when its bootstrap interval excludes zero. The 5,000 resamples do not create new observations and do not repair a weak design. They improve inference about the sampling uncertainty of the indirect-effect estimate under the fitted model. Increasing the number of resamples stabilizes the numerical interval, but it cannot establish temporal order, remove omitted-variable bias, or convert self-report measures into objective indicators.

Reading the Three Specific Indirect Effects

Table 3. Specific, serial, total, and direct effects

Effect	Estimate	95% bootstrap CI	Decision
X -> M1 -> Y	0.17	[0.14, 0.21]	Interval excludes zero
X -> M2 -> Y	0.13	[0.10, 0.17]	Interval excludes zero
X -> M1 -> M2 -> Y	0.03	[0.02, 0.05]	Interval excludes zero
Total effect	0.37	[0.33, 0.42]	Statistically significant
Direct effect c-prime	0.04	[-0.01, 0.08]	Not statistically significant

The M1-only effect indicates that mentoring was indirectly associated with professional identity through psychological capital while accounting for the other routes. The M2-only effect indicates an indirect association



through work engagement. The serial effect indicates that the data were consistent with the specifically ordered route from mentoring to psychological capital, from psychological capital to work engagement, and from engagement to professional identity. Its smaller magnitude does not make it unimportant; it represents the most theoretically restrictive pathway in the model.

The total effect of mentoring on professional identity was 0.37, whereas the remaining direct effect after including both mediators was 0.04 and not statistically distinguishable from zero. This pattern is sometimes called indirect-only mediation, but classification labels should not replace interpretation. A nonsignificant direct effect does not prove that mentoring matters only through the measured mediators, nor does it establish complete mediation. It states that the residual association represented by c -prime was not distinguishable from zero in this sample and model.

What The Model Adds To Novice-Teacher Research

The analytical value of Model 6 lies in decomposing a broad mentoring-identity relationship into theoretically interpretable routes. Mentoring may relate to identity because it strengthens efficacy, hope, resilience, and optimism; because it enables energetic and meaningful participation; or because personal resources are translated into engaged action before being incorporated into the professional self. Estimating the routes simultaneously prevents the serial claim from being inferred merely because two separate simple mediations are significant.

The model also disciplines the theoretical integration. Conservation of Resources theory supplies the logic of resource gain, the Job Demands-Resources model explains why personal resources may energize engagement, and Social Identity theory explains how participation in valued professional practices may become part of self-definition. PROCESS does not integrate these theories; the researcher does. Model 6 then estimates the observed-variable path system implied by that integration.

For the worked example, the decomposition illustrates how programme evaluation might distinguish mentor provision from the psychological and motivational processes with which mentoring is associated. This substantive interpretation is intentionally secondary to the methodological purpose: the example demonstrates how distinct indirect routes can be named and evaluated without converting cross-sectional coefficient products into claims of developmental causation.

Rival Models And Sensitivity As Part Of The Workflow

A theory-first analysis does not require pretending that the nominated sequence is the only conceivable one. At least three rivals deserve attention. First, engagement may precede psychological capital if successful participation generates efficacy, hope, and optimism. Second, professional identity may precede engagement because teachers who already identify strongly with the profession invest more energy in it. Third, mentoring may be partly endogenous: engaged or confident novices may seek, receive, or positively appraise more support. These alternatives cannot be dismissed by the significance of the proposed serial product.

With cross-sectional observed scores, re-estimating reversed mediator orders can be used as a sensitivity exercise, but it cannot select the true temporal model. A reversed analysis asks whether another set of regression products is also compatible with the covariance structure. If several orders yield nonzero indirect effects, the appropriate conclusion is that the data are underdetermining the process. If only the proposed order is supported, temporal caution is still required because omitted variables and measurement timing remain unchanged. Sensitivity analysis narrows overconfidence; it does not manufacture identification. Georgeson et al. (2025) demonstrate that cross-sectional indirect-effect estimates can differ from the longitudinal effects of interest under plausible temporal conditions; sensitivity analysis can reveal this fragility but cannot replace repeated observations.

Empirical Rival-Sequence Demonstration

To demonstrate the sensitivity analysis advocated by this article, a reversed mediator ordering was estimated using the same cross-sectional dataset. Mentoring remained X and professional identity remained Y , while work



engagement was entered as M1 and psychological capital as M2. The purpose was not to select a statistical winner but to examine whether the same covariance structure was also compatible with a theoretically different mediator ordering.

The reversed specification was estimated in PROCESS Version 4.2 with 5,000 bootstrap samples and 95% confidence intervals, using $N = 400$. In the reversed specification, mentoring was positively associated with work engagement, $B = .7833$, $SE = .0302$, $t = 25.9466$, $p < .001$, 95% CI [.7239, .8426]. Work engagement was positively associated with psychological capital conditional on mentoring, $B = .6173$, $SE = .0600$, $t = 10.2929$, $p < .001$, 95% CI [.4994, .7352], whereas the conditional association between mentoring and psychological capital was not statistically significant, $B = -.0331$, $SE = .0593$, $t = -.5594$, $p = .5762$, 95% CI [-.1496, .0833]. In the outcome equation, work engagement, $B = .2118$, $SE = .0275$, $t = 7.7028$, $p < .001$, 95% CI [.1577, .2659], and psychological capital, $B = .3797$, $SE = .0204$, $t = 18.5710$, $p < .001$, 95% CI [.3395, .4199], were positively associated with professional identity, whereas the remaining direct association of mentoring was not statistically significant, $B = .0370$, $SE = .0241$, $t = 1.5321$, $p = .1263$, 95% CI [-.0105, .0845]. The reversed serial indirect effect through work engagement followed by psychological capital was statistically distinguishable from zero, effect = .1836, BootSE = .0182, 95% bootstrap CI [.1476, .2194]. The work-engagement-only indirect effect was also supported, effect = .1659, BootSE = .0225, 95% bootstrap CI [.1220, .2116], whereas the psychological-capital-only indirect effect was not, effect = -.0126, BootSE = .0208, 95% bootstrap CI [-.0522, .0305]. This result does not establish that work engagement developmentally precedes psychological capital. Instead, it demonstrates that the same cross-sectional data are compatible with an alternative ordered mediation model, reinforcing the central argument that statistical ordering cannot independently establish developmental succession.

The most informative next study would build the sequence into data collection. Mentoring functions could be assessed early in the induction period, psychological capital after sufficient exposure to mentoring, engagement at a subsequent point, and identity later still. Repeated measurement would permit stability paths, reciprocal effects, and within-person change to be represented. An intervention could additionally manipulate the quality or content of mentoring. These designs would move the research question from whether an ordered product exists in simultaneous data toward whether change in one process precedes change in another.

Methodological Boundaries And Common Misinterpretations

A Statistical Sequence Is Not a Temporal Sequence

The principal limitation is the cross-sectional design. All four variables were measured at one occasion. The fitted order is theoretically specified, not observed unfolding through time. Hayes and Rockwood (2020) stress that statistics can quantify relationships relevant to a causal argument but cannot independently establish causation. Earlier methodological work demonstrates that cross-sectional mediation estimates can be substantially biased representations of longitudinal processes (Maxwell & Cole, 2007), and recent sensitivity work reinforces that single-wave indirect effects may diverge from the longitudinal effects of interest under plausible temporal conditions (Georgeson et al., 2025). Reciprocal explanations therefore remain plausible: engaged teachers may attract more mentor support, a stronger identity may encourage engagement, and psychologically resourceful novices may perceive mentoring more positively.

Stronger designs would measure mentoring earlier, psychological capital and engagement at intermediate occasions, and professional identity later. Cross-lagged panel, latent change, or intervention designs could compare the proposed ordering with reverse and reciprocal paths. Until then, the appropriate language is indirect association or statistically supported indirect effect within the specified model, not demonstrated causal mechanism.

Observed Scores Are Not Latent Variables

PROCESS uses regression-based path analysis with observed variables. Composite scores are treated as measured without explicit error, even though reliability is imperfect. Structural equation modelling would permit simultaneous estimation of measurement and structural models. The choice does not make PROCESS invalid; it



defines the level of inference. Researchers should report reliability, justify composite construction, inspect regression assumptions, and avoid presenting PROCESS as a substitute for measurement validation.

Significance Is Not Mechanistic Proof

A bootstrap interval excluding zero indicates that a particular product was distinguishable from zero under the fitted model. It does not verify that all relevant confounders were controlled, that the mediator order is unique, or that the process applies in every population. Effect estimates and intervals should be reported alongside *p* values, and alternative arrangements should be acknowledged when the design cannot discriminate among them.

Process Indirect Effects Are Not Causal Mediation Effects

Regression-based indirect effects estimated by PROCESS and causally identified mediation effects are not synonymous. A bootstrapped product of coefficients can quantify an indirect association under the fitted regression system, but a causal interpretation requires additional identification assumptions concerning exposure-outcome, exposure-mediator, and mediator-outcome confounding, as well as assumptions about post-exposure confounding and the consistency of the relevant counterfactual contrasts (Imai et al., 2010; VanderWeele, 2016). These assumptions are not established by bootstrap resampling. In a single-wave observational study, the appropriate interpretation is therefore a model-based indirect association rather than a natural direct or indirect effect identified causally.

When Not To Use Model 6

Model 6 should not be selected merely because two candidate mediators are available. A serial specification is difficult to defend when theory provides no credible ordering of the mediators, when mediator selection is purely exploratory, when measurement validity is inadequate, when constructs overlap so strongly that their substantive distinction is doubtful, when the timing of measurement contradicts the proposed sequence, or when theory implies parallel rather than ordered mediation. In these circumstances, a parallel model, a simpler mediation model, a latent-variable approach, or a redesigned longitudinal study may provide a more defensible representation of the research question. Model choice should therefore follow the mechanism and design, not the availability of a PROCESS template.

A Reproducible Reporting Workflow

Table 4. Minimum reporting checklist for PROCESS Model 6

Stage	Report
Theory	Why M1 precedes M2; plausible alternatives; construct functions
Data	Design, sample, timing, missing-data handling, scale construction, reliability
Specification	PROCESS version, model number, X, M1, M2, Y, covariates and coding
Estimation	Coefficient scale, bootstrap resamples, confidence level and interval rule
Results	All constituent paths, total and direct effects, each specific indirect effect
Interpretation	Magnitude and uncertainty; no causal overstatement for cross-sectional data
Reproducibility	Syntax, variable order, software version and analysis decisions

A clear report should allow a reader to reconstruct the model without consulting a diagram. The variable order must be stated in prose, and the three indirect effects must be named rather than collapsed into a single total indirect effect. Reporting only whether Model 6 was significant obscures which pathway is supported. Similarly,

reporting that the direct effect became nonsignificant is incomplete without the estimate, interval, and design qualification.

Discussion: From A Macro Output To A Methodological Argument

The worked example illustrates why Model 6 should be understood as a set of linked regression models rather than a black-box test. Each indirect effect answers a different question. The M1-only pathway represents resource internalization without requiring engagement as the carrier. The M2-only pathway represents engaged participation without requiring the proposed psychological-resource step. The serial pathway represents the more restrictive claim that contextual support is related to a personal resource, that resource is related to engagement, and engagement is related to identity. Treating these effects separately preserves the theoretical distinctions that motivated the analysis.

This separation also changes how effect magnitude should be discussed. The serial estimate was smaller than the two one-mediator estimates, but it contains an additional constituent path and represents a narrower route. It should not be dismissed merely because it is numerically smaller. Nor should a confidence interval excluding zero be described as practical importance. Substantive interpretation requires attention to the scales, plausible changes in X, uncertainty, and the institutional meaning of mentoring and engagement.

The Malaysian case contributes to international methodological discourse because educational constructs are often transported across systems while their institutional meanings vary. Mentoring may be formal or informal, evaluative or developmental, and shaped by hierarchy and deference. Psychological capital language may foreground individual adaptability even when organizational conditions constrain action. A methodologically responsible analysis therefore keeps the statistical model connected to the setting in which its variables were produced. Generalization concerns the plausibility of the mechanism and its boundary conditions, not merely whether coefficients are significant in another country. This contextual caution is supported by recent studies conducted across Chinese, German, Israeli, and Thai educational settings, where professional identity and engagement were associated with different configurations of psychological and relational resources (Li et al., 2022; Ma, 2023; Prabjandee, 2022; Vaitzman Ben-David & Berkovich, 2021; Weiß et al., 2023; Xu, 2023).

For editors and reviewers, the proposed workflow offers practical evaluation criteria. A Model 6 manuscript should not be judged by the presence of significant paths alone. Review should ask whether the mediator order was specified before results were known, whether the same variables could reasonably be reversed, whether each regression is reported, whether all specific indirect effects are visible, whether bootstrap settings are reproducible, and whether language distinguishes association from causation. These criteria shift quality assessment from software use to methodological reasoning.

CONCLUSION

Hayes PROCESS Macro Model 6 is most useful when treated as the computational implementation of an ordered theoretical account rather than as a procedure for discovering an ordered mechanism. In the novice-teacher illustration, mentoring was positioned as a contextual resource, psychological capital as a personal resource, work engagement as motivational enactment, and professional identity as the developmental outcome. The analysis distinguished two single-mediator routes from the theoretically central serial route and quantified their sampling uncertainty through bootstrap intervals. The results supported all three indirect associations, while the remaining direct mentoring coefficient was not statistically distinguishable from zero after the mediators were included. These results describe the fitted cross-sectional path system and do not establish causal or developmental succession.

The central methodological conclusion is that PROCESS Model 6 implements an ordered model that must already have been justified by theory; it is not an algorithm for discovering developmental mechanisms. A responsible analysis begins with a defensible mechanism, checks measurement and regression conditions, reports every constituent path and pathway-specific indirect effect, examines credible rival sequences, distinguishes regression-based indirect effects from causally identified mediation, and ends with claims calibrated to the



research design. Where developmental succession is the substantive target, stronger temporal or experimental designs are required.

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