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When The Institution Doesn't Guarantee The Pension: A Capacity-To-Behaviour Model Of Digital Financial Tools and Retirement Readiness Among Private Higher Education Academicians

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Abstract

A public-university lecturer in most systems retires into a pension the institution itself underwrites. A private-university lecturer usually does not. Retirement income depends on what that person personally saved, invested, and planned, often through the same mobile banking apps, robo-advisors, and digital pension calculators everyone else uses. This paper proposes a structural model of how digital financial tool adoption (DFTA) and financial self-efficacy (FSE) shape retirement planning readiness (RPR) among academicians at private higher-education institutions, and plans its statistical analysis in advance instead of reporting survey results. Financial behaviour (FB) is the mechanism that converts capability into readiness, and institutional financial-literacy support is a boundary condition on the DFTA-to-FB path. The model draws on the Theory of Planned Behaviour and the Capacity-Willingness-Opportunity framework. It extends two recent PLS-SEM studies, one linking digital financial literacy to retirement planning among Indian millennials, the other linking it to financial well-being among university faculty, to a population neither has tested: academicians whose employer does not guarantee their pension. Because the study has not yet been fielded, we report no survey findings. We report what can be reported at this stage: a measurement instrument adapted from validated prior scales and an a priori power analysis. A Monte Carlo simulation (400 replications per candidate sample size, 300 bootstrap resamples per mediation test), combined with the Kock and Hadaya (2018) inverse square root method, shows that 300 to 350 respondents give adequate power for the model's central mediated pathway. The direct effects of DFTA and FSE on readiness stay below 80% power at every sample size tested, and the hypothesised moderation effect remains underpowered (power below 0.50) even at 450 respondents. These findings bear directly on how the eventual study should be resourced and scoped. We present the paper as an analysis plan: the instrument, the framework, and the power budget that a private-HEI retirement-readiness survey would need, ahead of collecting data from academicians and not in place of it.

Keywords: digital financial tools; retirement planning readiness; financial behaviour; financial self-efficacy; private higher education; PLS-SEM; a priori power analysis; academicians.

1. Introduction

Retirement security for a salaried professional in most economies rests on three legs: a state pension, an employer-sponsored scheme, and personal saving. For academic staff at private higher-education institutions (HEIs), the second leg is often thin or absent. Unlike government university faculty, who in many countries participate in defined-benefit or employer-guaranteed pension schemes, private-HEI academicians typically rely on defined-contribution instruments they must select, fund, and monitor themselves, through exactly the digital banking apps, mutual fund platforms, and retirement calculators that constitute the current wave of financial technology (Arner et al., 2016). That shift places an unusual weight on two things: whether an academician can actually use these tools (their digital financial capability), and whether they believe they can (their financial self-efficacy).

A substantial and fast-growing literature connects digital financial literacy to retirement-related outcomes. Khurana and Sharma (2026), in a PLS-SEM study of 307 digitally active Indian millennials, found that digital

financial literacy raised both willingness to plan and retirement planning behaviour, working through a Capacity-Willingness-Opportunity lens. Digital literacy explained 37% of the variance in willingness to plan and, together with willingness, 54% of the variance in planning behaviour itself. Kumar and Kaur (2026), studying 517 university faculty members in the Delhi-NCR region, found that digital financial literacy shaped financial well-being both directly and indirectly, with financial behaviour and financial self-efficacy as partial mediators. Both studies are recent and directly relevant. Neither, however, isolates academicians at private institutions, and neither treats the absence of an employer-guaranteed pension as a variable that might change how digital capability translates into readiness. Kumar and Kaur's faculty sample was not selected on employment sector, and their outcome, financial well-being, is broader than retirement readiness. Khurana and Sharma's millennial sample spans occupations rather than academic staff.

This is not a small omission. Private higher education has expanded rapidly across South and Southeast Asia over the past two decades, and its academic workforce is a captive test case for self-directed retirement planning: highly educated, often digitally literate by profession, yet exposed to exactly the planning burden that a guaranteed pension would otherwise absorb. If digital financial tools and financial self-efficacy matter anywhere for retirement readiness, they should matter here, where the stakes of getting the mechanism right are high and where an institution has some room to intervene, through financial-literacy workshops, retirement-benefit counselling, or better default options in whatever provident or superannuation scheme it does offer. The point extends beyond any one country. Wherever private-sector academic employment has grown faster than public-sector academic employment, a growing share of the most educated professionals is being asked to self-manage a risk that an earlier generation of government-employed academics did not have to.

This paper's contribution is deliberately narrower than a completed empirical study. We build a conceptual model with eight hypotheses, grounded in the Theory of Planned Behaviour (Ajzen, 1991) and the Capacity-Willingness-Opportunity framework (Topa et al., 2018). It extends Khurana and Sharma's (2026) and Kumar and Kaur's (2026) models to private-HEI academicians and adds an institutional-support moderator that neither study tested. We then do what should precede fielding a survey of a new population: an a priori statistical power analysis. We use both a closed-form minimum-sample-size formula (Kock & Hadaya, 2018) and a Monte Carlo simulation whose population parameters are set conservatively below what the two closest prior studies found in their own, different samples. This shows how large a sample the eventual study needs and, more usefully, where that sample size will and will not be adequate. The answer, previewed here, is uncomfortable but useful. The mediated pathway and the effects of the exogenous constructs on financial behaviour are well powered at realistic sample sizes, but the moderation hypothesis and the direct effects on readiness are not, which should change how the actual study is designed, not just how it is written up.

The rest of the paper is organised as follows. Section 2 reviews the digital-financial-tools, self-efficacy, and retirement-planning literatures behind the model, positions the proposed study against the two closest prior PLS-SEM studies, and develops all eight hypotheses. Section 3 sets out the conceptual model. Section 4 describes the proposed research design, sampling plan, and measurement instrument, and specifies the power-analysis methodology. Section 5 reports the results of that power analysis, which are Monte Carlo and closed-form computations, not survey findings. Sections 6 through 9 discuss the findings and their theoretical and practical implications, set out the limitations, and outline directions for the data collection this protocol is designed to precede.

2. Literature Review

2.1 Digital Financial Tools as Capacity

Digital financial literacy (DFL) has been defined as the knowledge, skills, and confidence needed to use digital financial products safely and effectively (Lyons & Kass-Hanna, 2021), and treated in the OECD/INFE toolkit as a distinct extension of traditional financial literacy that adds digital comprehension, cybersecurity awareness, and platform navigation to the older competencies of budgeting and saving (OECD, 2022). Chhillar et al. (2024) and Ravikumar et al. (2022) have each developed and validated multidimensional DFL scales in Indian contexts specifically, both converging on a similar structure: awareness of digital financial products, ability to transact securely, ability to evaluate digital financial information, and basic cyber-risk protection.

For this paper, digital financial tool adoption (DFTA) is treated as the behavioural and attitudinal counterpart of DFL, capturing not just whether a person knows how to use mobile banking, robo-advisory platforms, or online retirement calculators, but whether they actually do, routinely and with confidence. Grohmann (2018)

found that stronger financial literacy predicted more effective saving and investing decisions across the emerging Asian middle class, and Morgan and Trinh (2019) showed that financial literacy specifically supported the uptake of fintech services in an emerging-market setting. Mishra et al. (2024) found DFL improved financial decision-making and investment intention among Indian women specifically, and Abdurrahman and Nugroho (2024) found that comfort navigating digital financial platforms predicted more consistent saving, budgeting, and financial monitoring. Most directly, Khurana and Sharma (2026) found DFL had a strong direct effect on willingness to plan for retirement ($\beta = 0.612$) and a moderate direct effect on retirement planning behaviour itself ($\beta = 0.364$) among Indian millennials.

2.2 Financial Self-Efficacy

Financial self-efficacy (FSE), a domain-specific application of Bandura's self-efficacy construct, captures a person's belief in their own capacity to manage financial tasks and achieve financial goals (Lown, 2011). It is conceptually distinct from DFTA: a person can be objectively capable of using a retirement calculator (capacity) while doubting their ability to use it well or to act on what it tells them (efficacy), and the two need not move together. Farrell et al. (2016) found financial self-efficacy a significant predictor of personal finance behaviour among women independent of financial knowledge, and Kumar and Kaur (2026) found financial self-efficacy partially mediated the DFL-to-financial-well-being relationship among university faculty alongside financial behaviour, suggesting the two mediators operate through at least partially distinct channels.

2.3 Financial Behaviour as the Conversion Mechanism

Financial behaviour (FB), the actual pattern of saving, budgeting, investing, and monitoring a person undertakes, has repeatedly emerged in this literature not as an outcome in itself but as the pathway through which capability becomes result. Yadav et al. (2025) found saving behaviour partially mediated the relationship between digital financial literacy and retirement planning among Indian respondents; Harahap et al. (2022) found a serial mediation running through financial risk tolerance and saving behaviour in an Indonesian entrepreneur sample; Stolper and Walter (2017) reviewed the broader financial-literacy-to-behaviour literature and concluded that literacy's effects on outcomes are substantially channelled through behaviour rather than acting directly. The pattern is consistent across these studies: capability shapes behaviour, and behaviour shapes the outcome. It is the backbone of the model proposed here.

2.4 Retirement Planning Readiness and the Private-HEI Gap

Retirement planning readiness (RPR), following Herrador-Alcaide et al. (2021) and the broader retirement-planning literature (Hershey & Mowen, 2000; Hershey et al., 2012; Lusardi & Mitchell, 2011), is treated here as a multidimensional state encompassing not only saving behaviour narrowly but goal clarity, estimation of retirement needs, engagement with formal retirement instruments, and psychological preparedness for the transition itself, distinguishing it from the behaviour construct (FB) that is hypothesised to produce it. Van Rooij et al. (2012) and Lusardi and Mitchell (2014) established, across multiple national contexts, that financial literacy predicts both retirement planning and eventual household wealth; Stawski et al. (2007) identified goal clarity specifically as a determinant of retirement savings contributions; Tomar et al. (2021) found retirement goal clarity and social-group support strong predictors of planning behaviour among Indian professional women, with future time perspective operating only indirectly.

What none of this literature does, including the two studies this paper builds on most directly, is treat pension-guarantee status as a contextual variable. Jaafar et al. (2022) found that among Malaysian millennials, saving behaviour and financial stress predicted retirement preparedness more strongly than financial literacy alone, a result the authors attribute partly to Malaysia's structural retirement landscape. Kumaraguru et al. (2022) found that attitudes and perceived behavioural control, rather than demographic factors, drove retirement preparation among Malaysian Gen Y. These country-level structural effects suggest the kind of institutional variation that this paper argues also matters within a single country. An academician whose employer funds a defined-benefit pension faces a fundamentally different planning problem from one whose employer does not, even if their digital literacy, self-efficacy, and income are identical. If the theory holds, the capacity-to-behaviour-to-readiness chain traced in general populations should matter more, not less, for private-HEI academicians who lack that institutional floor. Institutional financial-literacy support (workshops, counselling, retirement-benefit communication) then becomes a variable to test rather than assume away.

2.5 Positioning Relative to the Two Closest Prior Studies

Table 1 summarises how this paper's proposed model relates to Khurana and Sharma (2026) and Kumar and Kaur (2026), since both are close enough in method and constructs that the differences are worth stating precisely. All three share a PLS-SEM approach and a financial-behaviour-type mediator. They diverge on population (Indian millennials generally; Delhi-NCR university faculty generally; private-HEI academicians

screened on pension-guarantee status), on outcome construct (retirement planning behaviour; financial well-being; retirement planning readiness, which is narrower than well-being and specific to retirement), and on whether a contextual moderator is tested. Neither prior study includes one, while this paper's model treats institutional financial-literacy support as a boundary condition worth testing rather than assuming constant across respondents.

Table 1: Comparative positioning against the two closest prior PLS-SEM studies

Study	Population	Outcome construct	Mediator(s)	Moderator tested?
Khurana & Sharma (2026)	Indian millennials, digitally active (general population)	Retirement planning behaviour	Willingness to plan	No
Kumar & Kaur (2026)	University faculty, Delhi-NCR (general, no pension screen)	Financial well-being	Financial behaviour + Financial self-efficacy	No
This paper (proposed)	Private-HEI academicians, screened for no guaranteed pension	Retirement planning readiness	Financial behaviour	Yes — institutional support

That comparison also clarifies what this paper does not claim. It does not claim that private-HEI academicians will show a stronger capacity-to-readiness pathway than Khurana and Sharma's millennials or Kumar and Kaur's general faculty sample. That is an empirical question the literature motivates but does not settle, and this paper offers a protocol for answering it, not the answer. What the comparison does establish is that no existing published PLS-SEM model in this space combines the population screen (pension-guarantee status) with the institutional moderator proposed here. That is the specific, checkable sense in which the model is new rather than a relabelling of either prior study.

2.6 Hypotheses Development

Drawing on the Capacity-Willingness-Opportunity framework (Topa et al., 2018) and the Theory of Planned Behaviour (Ajzen, 1991), in which perceived behavioural control, the TPB analogue of self-efficacy, and capability jointly shape intention and, through it, behaviour, the following hypotheses are proposed.

H1: Digital financial tool adoption (DFTA) is positively associated with financial behaviour (FB).

H2: Financial self-efficacy (FSE) is positively associated with financial behaviour (FB).

H3: Financial behaviour (FB) is positively associated with retirement planning readiness (RPR).

H4: Digital financial tool adoption (DFTA) is directly and positively associated with retirement planning readiness (RPR).

H5: Financial self-efficacy (FSE) is directly and positively associated with retirement planning readiness (RPR).

H6: Financial behaviour (FB) mediates the relationship between digital financial tool adoption (DFTA) and retirement planning readiness (RPR).

H7: Financial behaviour (FB) mediates the relationship between financial self-efficacy (FSE) and retirement planning readiness (RPR).

H8: Institutional financial-literacy support moderates the relationship between digital financial tool adoption (DFTA) and financial behaviour (FB), such that the relationship is stronger where institutional support is higher.

3. Conceptual Framework

Figure 1 sets out the full model. DFTA and FSE are modelled as parallel exogenous capacity constructs, consistent with Kumar and Kaur's (2026) finding that financial behaviour and financial self-efficacy operate as at least partially distinct mediating channels rather than a single combined pathway. Both feed FB directly (H1, H2) and RPR directly (H4, H5), and FB is the mediating mechanism (H3, H6, H7), consistent with the capacity-to-behaviour-to-outcome pattern across the reviewed literature. Institutional financial-literacy support moderates the DFTA-to-FB path specifically (H8). The reasoning is that institutional support most plausibly affects how digital tools already adopted get translated into behaviour, not self-efficacy, which the literature treats as a more stable individual trait (Lown, 2011).

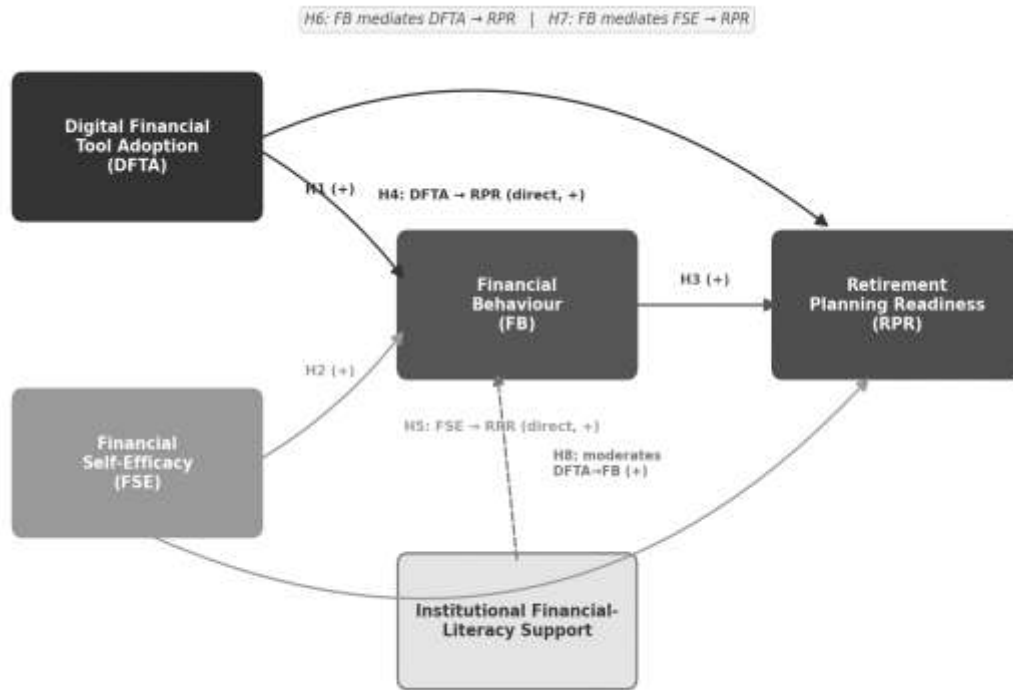


Figure 1: Proposed conceptual model

4. Methodology

4.1 Research Design and Target Population

A quantitative, cross-sectional survey design is proposed, consistent with the two closest prior studies (Khurana & Sharma, 2026; Kumar & Kaur, 2026) and the broader PLS-SEM literature in this domain. The target population is full-time academic staff (assistant professors through professors, including equivalent designations) at private, non-government higher-education institutions. Institutions whose staff participate in a government-guaranteed defined-benefit pension scheme are specifically excluded, since that institutional feature is the theoretical boundary condition motivating the study. A screening question at survey entry would confirm both employment status and pension-scheme type before routing a respondent into the main instrument.

4.2 Sampling Plan

Purposive sampling across multiple private HEIs, stratified where feasible by institution size and discipline, is proposed instead of single-institution convenience sampling, so that the institutional-support moderator (H8) is not confounded with any single institution's policies. Section 5 reports the a priori power analysis that sets the minimum sample size this plan should target.

4.3 Measurement Instrument

Table 2 summarises the proposed instrument. All items would use a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), as in both benchmark studies. The four core constructs are adapted from previously validated scales rather than written from scratch, following standard PLS-SEM instrument-development practice (Hair et al., 2019); the fifth, institutional financial-literacy support, is new and is described below.

Table 2: Proposed measurement instrument (all constructs except institutional support adapted from validated prior scales)

Construct	Definition	Items	Adapted from
Digital Financial Tool Adoption (DFTA)	Routine, confident use of digital financial platforms and tools for financial management	4	Chhillar et al. (2024); Ravikumar et al. (2022)

Financial Self-Efficacy (FSE)	Belief in one's own capacity to manage financial tasks and achieve financial goals	4	Lown (2011)
Financial Behaviour (FB)	Actual saving, budgeting, and financial-monitoring practices undertaken	4	Lusardi & Mitchell (2011); Yadav et al. (2025)
Retirement Planning Readiness (RPR)	Goal clarity, needs estimation, and engagement with formal retirement instruments	4	Herrador-Alcaide et al. (2021); Stawski et al. (2007)
Institutional Financial-Literacy Support	Perceived availability of employer-provided financial-literacy and retirement-benefit resources	3	Newly developed for this study; requires pilot validation

Digital financial tool adoption (DFTA) items are adapted from Chhillar et al. (2024) and Ravikumar et al. (2022) and cover routine use of mobile and online banking, comparison of digital financial products, digital security practices, and use of online retirement or investment calculators. Financial self-efficacy (FSE) items are adapted from Lown's (2011) validated scale. Financial behaviour (FB) items draw on Lusardi and Mitchell (2011) and Yadav et al. (2025) and cover regular saving, budget adherence, and monitoring of financial accounts. Retirement planning readiness (RPR) items are adapted from Herrador-Alcaide et al. (2021) and Stawski et al. (2007) and cover goal clarity, estimation of retirement needs, and engagement with formal retirement instruments. Institutional financial-literacy support items are newly developed for this study because no validated scale for this construct was located in the reviewed literature. They cover whether the respondent's institution offers financial-literacy workshops, retirement counselling, or accessible information about retirement benefit options. As a new measure, it would need the pilot-testing and content-validity procedure in Section 4.4 before use in the main study.

A screening block at the start of the instrument, separate from the substantive constructs in Table 2, would capture institution type (private, non-government-pension-guaranteed, confirmed), academic rank, years of service, discipline, and whether the respondent's institution offers any employer-contributed retirement scheme at all, as opposed to a purely self-directed arrangement. This last item is a plausible additional moderator or control variable that emerged from the literature review but is not built into the eight core hypotheses. It is flagged here as worth capturing even though it sits outside the tested model, because such decisions are easier to get right before fielding than to regret afterwards.

4.4 Instrument Validation Procedure

Following Khurana and Sharma (2026), a two-stage validation is proposed: expert review of all items for content relevance and clarity, then a pilot administration to about 30 respondents from the target population to assess item comprehension and preliminary reliability, before the item set is finalised. Common method bias would be assessed procedurally, through psychological separation of predictor and outcome items in the survey flow, and statistically, through Harman's single-factor test and full collinearity variance inflation factors, as in both benchmark studies.

4.5 Analytical Strategy

Partial least squares structural equation modelling (PLS-SEM), implemented in SmartPLS 4 (Ringle et al., 2023), is proposed as the analytical method, for the reasons both benchmark studies adopted it: it suits prediction-oriented, exploratory models with a moderation term, is robust to non-normal data, and allows comparison with the two most closely related published studies. The measurement model would be assessed through indicator loadings, Cronbach's alpha, composite reliability, and average variance extracted (AVE), with discriminant validity assessed through the heterotrait-monotrait ratio (HTMT) and the Fornell-Larcker criterion (Fornell & Larcker, 1981). The structural model would be tested by bootstrapping with 5,000 subsamples, with mediation assessed using the bias-corrected bootstrap procedures of Preacher and Hayes (2008), as in both benchmark studies.

4.6 A Priori Power and Sample-Size Planning

Before any of the analysis in Section 4.5 can run on collected data, the survey needs a target sample size. That target should be set by what the model needs in order to detect its hypothesised effects, not by convenience or rules of thumb alone. Two complementary approaches were used, both run as computations for this paper and not asserted as round numbers.

First, the Kock and Hadaya (2018) inverse square root method was applied. It gives a closed-form minimum sample size as a function of the smallest population path coefficient the model needs to detect, at $\alpha = .05$ and

80% power. Four candidate minimum-path scenarios were computed, from the moderation term (assumed $\beta = 0.12$, the smallest and least certain effect in the model) up to a typical main-effect path drawn from prior literature ($\beta = 0.35$).

Second, a Monte Carlo simulation was built for this model's structure: DFTA and FSE as parallel predictors of FB, FB predicting RPR alongside direct DFTA and FSE paths, and an institutional-support interaction term on the DFTA-to-FB path. Population path coefficients were set deliberately below the comparable effects that Khurana and Sharma (2026) and Kumar and Kaur (2026) found in their own populations (see Table 3). That is the conservative choice for planning a study in a population, private-HEI academicians, that neither prior study tested. For each of eight candidate sample sizes (100 to 450, in steps of 50), 400 independent datasets were simulated under these parameters, each with four reflective indicators per construct at an assumed loading of 0.75. Each dataset was analysed by ordinary least squares on standardised composite scores, and the significance of each hypothesised path was recorded. The mediated (indirect) effect was additionally tested with a nested bootstrap of 300 resamples per replication. Empirical power at each sample size is the proportion of the 400 replications in which the effect was significant.

Table 3: Assumed population parameters for the a priori Monte Carlo power simulation

Hypothesised path	Assumed population β	Basis for the assumption
H1: DFTA $\rightarrow$ FB	0.30	Set below Khurana & Sharma's (2026) DFL $\rightarrow$ WTP path ($\beta=0.612$), conservative for an untested population
H2: FSE $\rightarrow$ FB	0.25	Consistent with Kumar & Kaur's (2026) partial-mediation finding via financial self-efficacy
H3: FB $\rightarrow$ RPR	0.35	Set below Khurana & Sharma's (2026) WTP $\rightarrow$ RPB path ($\beta=0.450$)
H4: DFTA $\rightarrow$ RPR (direct)	0.15	Residual direct effect after mediation, conservatively smaller than the mediated path
H5: FSE $\rightarrow$ RPR (direct)	0.15	Residual direct effect after mediation, set equal to H4 for symmetry in planning
H8: DFTA $\times$ Support $\rightarrow$ FB (interaction)	0.12	No prior published effect size available; set at the conventional small-effect boundary

5. Results: A Priori Statistical Power Analysis

Table 4 and Figure 2 report the Monte Carlo power curves for all eight sample sizes tested. The effects of both exogenous constructs on financial behaviour (H1, H2) and the effect of financial behaviour on retirement planning readiness (H3) all reach conventional 80% power by $n = 200$, consistent with the closed-form inverse-square-root estimate of $n = 155$ for a moderate ($\beta = 0.20$) path (Figure 4). The mediated effect (DFTA through FB to RPR, the mechanism in H6) tracks closely behind: it reaches 80% power between $n = 150$ and 200 and 97% by $n = 250$.

Table 4: Empirical statistical power by sample size (400 replications per cell)

n	H1 DFTA $\rightarrow$ FB	H2 FSE $\rightarrow$ FB	H3 FB $\rightarrow$ RPR	H4 DFTA $\rightarrow$ RPR	H5 FSE $\rightarrow$ RPR	H8 Interaction	Mediation DFTA $\rightarrow$ FB $\rightarrow$ RPR
100	0.675	0.520	0.780	0.237	0.275	0.160	0.512
150	0.870	0.718	0.890	0.403	0.370	0.207	0.785
200	0.927	0.820	0.970	0.450	0.420	0.253	0.895
250	0.975	0.863	0.998	0.550	0.482	0.268	0.970
300	0.988	0.922	0.995	0.623	0.595	0.335	0.985
350	0.993	0.975	0.998	0.710	0.720	0.405	0.990
400	0.995	0.983	1.000	0.723	0.728	0.435	0.990
450	0.998	0.990	1.000	0.780	0.720	0.460	1.000

Note. Power = proportion of 400 Monte Carlo replications in which the path was significant at $\alpha = .05$. Mediation tested via 300 bootstrap resamples per replication, 95% CI excluding zero.

Figure 2: Monte Carlo power curves by hypothesised path

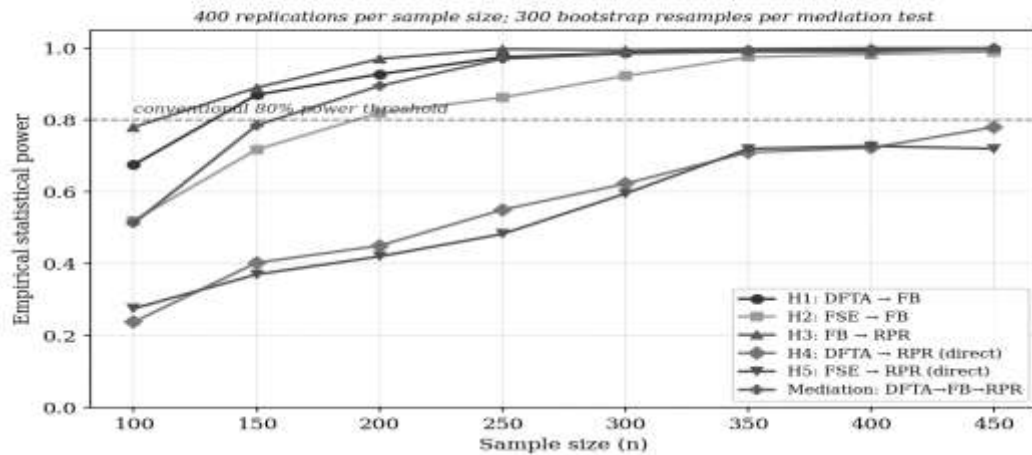


Figure 2: Monte Carlo power curves by hypothesised path

The direct effects of DFTA and FSE on retirement planning readiness (H4, H5), net of the mediator, tell a different story. Power climbs more slowly, reaching only 48 to 55% at $n = 250$ and 72 to 78% even at the largest sample size tested, $n = 450$. This is not a coding artefact. It is the expected signature of a well-specified mediation model: once financial behaviour is controlled for, the residual direct effect of either exogenous construct on the outcome is, by the model's own logic, smaller than the total effect, and smaller effects need larger samples to detect at conventional power.

The moderation hypothesis (H8) is the clearest actionable finding of this planning exercise. Power to detect the DFTA-by-institutional-support interaction stays below the 80% threshold at every sample size tested, reaching only 46% at $n = 450$ (Figure 3). The Kock and Hadaya closed-form method independently estimates that detecting an interaction of the assumed size ($\beta = 0.12$) at conventional power would need about 429 respondents on its own, before counting the extra estimation burden of a full structural model with several other paths (Figure 4). Interaction effects are well documented in the PLS-SEM methodology literature as harder to detect than main effects at a given sample size (Hair et al., 2021), and this simulation confirms the pattern for this specific model instead of asserting it generically.

Figure 3: Power to detect the moderation effect (H8)

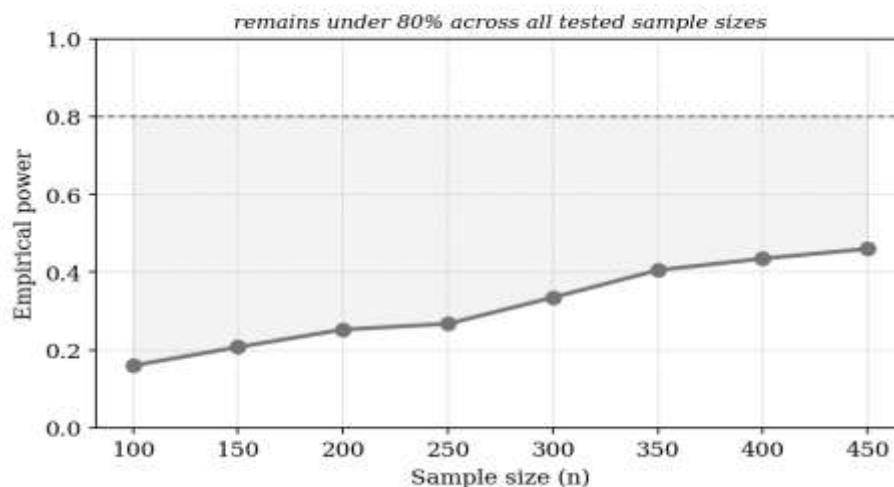


Figure 3: Power to detect the moderation effect (H8) by sample size

Figure 4: Kock & Hadaya (2018) inverse square root minimum-n

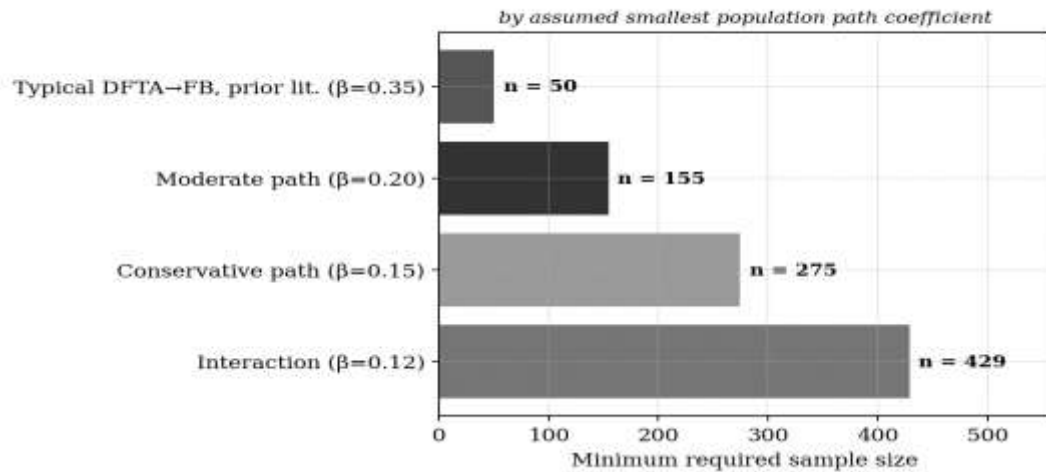


Figure 4: Kock & Hadaya (2018) inverse square root minimum-n by assumed path size

6. Discussion

The headline from this planning exercise is that no single target sample size serves every hypothesis in this model equally well. A sample of 300, comfortably achievable for a multi-institution private-HEI survey, would give strong power for the central capacity-to-behaviour-to-readiness pathway (H1 through H3 and the mediated effect in H6), the part of the model that the literature review identifies as most theoretically load-bearing. The direct effects on readiness (H4, H5) stay short of 80% power up to $n = 450$, as a mediated model implies. That same sample of 300 would leave the moderation hypothesis (H8) underpowered by a wide margin, and even raising the target to 450 would not fully close the gap.

Three responses to this finding are available, and the choice between them is an empirical planning decision that this simulation makes possible, not a matter of guessing. First, the study could proceed with a sample of 300 to 350, treat the moderation test as exploratory and likely underpowered, and report that limitation transparently instead of omitting the moderator or overselling a null or marginal result. Second, the study could oversample institutions with strong and weak financial-literacy support programmes. This stratified design would increase the effective variance in the moderator itself and could improve power for H8 at a given total n beyond what this simulation, which assumed simple random sampling on the moderator, estimates. Third, if institutional resources allow, the target could be set at or above 450 to bring the moderation test closer to conventional power, accepting that even this may not suffice if the true interaction is smaller than the conservative $\beta = 0.12$ assumed here.

This pattern also bears on how the two benchmark studies should be read. Khurana and Sharma (2026) worked with $n = 307$ and found their central mediated pathway strongly significant; Kumar and Kaur (2026) worked with $n = 517$. Neither tested a moderator of this kind, so neither faced this specific power problem. The general lesson still applies: a sample adequate for a study's headline mediation finding is not automatically adequate for every hypothesis that a more elaborate model adds. Reporting only the headline finding, without checking whether the full hypothesis set was well powered, risks the kind of underpowered, non-replicable moderation claim that the methodology literature flags as a persistent problem (Hair et al., 2021).

A further observation comes from comparing the closed-form and simulation-based estimates directly. The inverse square root method puts the minimum sample for detecting the moderation term at $n = 429$ in isolation. The Monte Carlo simulation embeds the same interaction in a multi-path structural model in which two other predictors and a mediator compete for the same degrees of freedom, and it finds power still below 50% at $n = 450$. The gap is informative. A closed-form heuristic calibrated on one effect in isolation will generally be optimistic relative to how that effect behaves when estimated jointly with everything else in a realistic structural model, which is why both tools were run here. A researcher relying only on the inverse square root figure would reasonably, but wrongly, conclude that $n = 450$ comfortably covers the moderation hypothesis; the simulation shows that conclusion does not hold up against the model's actual structure.

7. Theoretical and Practical Implications

Theoretically, this paper extends the capacity-to-behaviour-to-readiness pathway, established for general millennial and broad university-faculty populations by Khurana and Sharma (2026) and Kumar and Kaur (2026), to a population defined by a structural condition that theory predicts should make the pathway matter more: the absence of an employer-guaranteed pension. Whether it does remains an empirical question this paper has not answered. What it has done is specify what data would be needed to answer it, and at what sample size each part of the answer becomes trustworthy.

A second, methodological contribution follows from the power analysis itself. PLS-SEM studies in this literature, including both benchmark studies, typically justify their achieved sample size after the fact, by citing the ten-times rule or a general power benchmark, rather than running a model-specific a priori simulation before data collection. Section 4.6 and Section 5 give a worked example showing that a model-specific Monte Carlo simulation can surface planning-relevant information that a generic post hoc justification would not: main effects and moderation effects within the same model can require substantially different sample sizes. Future PLS-SEM studies proposing models with interaction terms would benefit from running this kind of simulation at the design stage instead of relying on rules of thumb calibrated for simpler models.

Practically, the power analysis carries a lesson for any private HEI, or researcher-institution partnership, considering a retirement-readiness intervention or survey. Institutional stakeholders should not expect a single, modestly sized pilot survey to show credibly whether their financial-literacy support programmes work; that is the underpowered question in this model. A modest survey can speak credibly to a more basic and, for programme design, more foundational question: whether digital tool adoption and financial self-efficacy are converting into financial behaviour and retirement readiness among their academic staff at all. That is the well-powered part of the model.

For HR and finance departments at private HEIs, this suggests two stages instead of one survey attempting everything. A first-stage survey at $n = 250$ to 300 could establish, with adequate power, whether the core capacity-to-readiness pathway holds for a given institution's academic staff, cheaply enough to run at department or campus level. Only if that stage motivates investment in financial-literacy programming would a larger, multi-institution second stage, built and pre-registered around the moderation question, be worth the additional data-collection cost that H8 requires. The staged approach also has a governance advantage. It avoids the common failure in which a single underpowered survey produces a null moderation result that is reported, and acted on, as evidence that institutional support does not matter, when it may only show that the study could not detect whether it does.

8. Limitations and Future Research

This paper's central limitation is that it reports a research protocol and an a priori power analysis, not empirical findings from surveyed private-HEI academicians, because no such survey has yet been fielded. The population parameters behind the Monte Carlo simulation (Table 3) are assumptions, set conservatively below comparable published effects as a defensible planning choice, but they remain assumptions and not measurements. The true parameters could differ in either direction. If the true effects in this population are larger than assumed, the sample-size recommendations in Section 5 are conservative and the study would be better powered than projected. If they are smaller, which is particularly plausible for the moderation term given how little prior evidence exists on institutional financial-literacy support, the projections here would be optimistic.

The simulation uses standardised composite scores estimated by ordinary least squares as a computationally tractable proxy for full PLS-SEM estimation. This is a standard and defensible simplification for a priori power planning, but it is not identical to running SmartPLS's actual algorithm, and a full PLS-SEM Monte Carlo power simulation, though computationally heavier, would be a reasonable refinement once the instrument is finalised. The institutional financial-literacy support measure is newly developed rather than adapted from a validated scale, since none was located, and its psychometric properties are unknown until the pilot testing in Section 4.4 is carried out. It is also, by construction, the weakest-measured construct in the model, which may contribute to the moderation term's low projected power independent of the true effect size. Finally, the protocol proposes a cross-sectional design, as both benchmark studies used, which, as those studies' authors note, cannot establish causal direction between financial behaviour and retirement readiness. A longitudinal extension following the same academicians across two or more waves would be a natural next step once the instrument has been validated. It would also let the institutional-support moderator be measured as an actual

change in programming over time rather than a single cross-sectional rating, which could improve the moderator's measurement quality and, with it, the realistic power to detect H8.

9. Conclusion

Two questions motivated this paper. What should a rigorous model of digital financial tools, financial behaviour, and retirement readiness look like for academicians at private higher-education institutions, a population that existing literature has not directly tested despite its distinctive exposure to self-directed retirement planning? And how large a sample would a study of that model need in order to trust each of its findings, not just the headline one? The first question is answered with a conceptual model and an instrument built on validated scales, extending two recent PLS-SEM studies (Khurana & Sharma, 2026; Kumar & Kaur, 2026) to a new population and adding an institutional-support moderator neither tested. The second is answered with a reproducible power analysis instead of a rule of thumb. A sample of 300 to 350 will adequately power the model's central mediated pathway, while a sample as large as 450 will still leave the moderation hypothesis underpowered, a specific and actionable finding for whoever fields this survey next. Presenting the study at the protocol stage, with its instrument items, framework, and power analysis, instead of presenting invented results as though data collection had already happened, is slower than the alternative. It is also the more defensible version, since decisions about academicians' retirement security should rest on evidence and not on invented results.

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