



Determinants of Competency Development in Physical Education: The Mediating Role of Motivation and Engagement

Hatim Ben Seddik^{1ABCDE}, Hiba Rimy^{2ABCDE}, Samir Essafi^{2ABCDE}, Achraf Fikri^{1ABCDE},
Badreddine Labakoum^{3ABCDE}, Chaïma Khali^{2ABCDE} and Soulaïman Harfouf^{1ABCDE}

¹Abdelmalek Essaâdi University

²Hassan I University

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Corresponding Author: Hatim Ben Seddik, e-mail: Hatimbenseddik17@gmail.com

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Abstract

Objectives. This study tested a serial mediation model examining how pedagogical feedback and prior sport experience are associated with the development of perceived competencies in physical education (PE) through the sequential mediating roles of motivation and engagement.

Materials and Methods. Participants were 248 undergraduate students (Year 1: n = 91; Year 2: n = 92; Year 3: n = 65; 125 males, 123 females) enrolled in a Bachelor's degree program in Physical Education and Sport at the École Normale Supérieure of Martil, Abdelmalek Essaâdi University, Morocco. Data were collected via an online, cross-sectional questionnaire comprising five eight-item Likert scales measuring motivation, perceived pedagogical feedback, engagement, prior sport experience, and perceived competency development, all self-reported by participants. Internal consistency was excellent for all scales (Cronbach's $\alpha > .91$). Two serial mediation models were tested using bootstrap resampling (5,000 iterations, 95% percentile confidence intervals).

Results. Both perceived pedagogical feedback and prior sport experience were significantly associated with perceived competency development. These relationships were partially accounted for by motivation and engagement (67% and 47% of the total association, respectively). Engagement emerged as the mediator most strongly associated with perceived competency development in both models. Notably, the indirect association through motivation alone was not significant for prior sport experience. No substantial differences were found across academic years, whereas prior competition participation correlated significantly with all five self-reported constructs. Given the cross-sectional, self-report design, these associations should not be interpreted causally.

Conclusions. Motivation and engagement operate as sequential, partially distinct mediators of the association between pedagogical feedback, prior sport experience, and perceived competency development. These findings offer important theoretical and practical implications for physical education teacher training, particularly regarding feedback design and differentiated support based on students' competitive backgrounds.

Keywords: engagement, feedback, motivation, physical education, self-efficacy, serial mediation, teacher training.

Introduction

The development of competencies in physical education (PE) among pre-service teachers constitutes a central issue in initial teacher training, insofar as the quality of this learning directly conditions their future professional practice. Teachers who enter the profession with well-developed technical, pedagogical, and reflective competencies are better equipped to design effective learning experiences, to

adapt their teaching to diverse student needs, and to sustain their own professional engagement over time. Conversely, gaps in competency development during training tend to persist into early career practice, making the identification of the levers that support this development during the university years a priority for teacher education research and policy alike.

While the literature agrees on the importance of student motivation and engagement in this process, the pathways through which contextual and experiential factors are associated with competency development remain insufficiently documented in the specific context of university-level PE teacher training. Much of the existing

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evidence on motivation and engagement in PE has been produced with school-age pupils rather than with pre-service teachers themselves, leaving open the question of whether, and how, the same motivational and experiential associations hold once students are the ones being trained to teach the subject. This gap is compounded by recent observational evidence suggesting that pedagogical competencies among PE pre-service teachers do not necessarily progress in a linear fashion across the years of training (Mellado-Berenguer & Monfort-Pañego, 2026; Salin, Huhtiniemi, Watt, Sääkslahti, & Jaakkola, 2025), which raises the question of which psychological factors, rather than seniority alone, are most closely associated with competency gains during PE teacher education.

Self-determination theory (Deci & Ryan, 1985, 2000) posits that the satisfaction of basic psychological needs — autonomy, perceived competence, and relatedness — fosters autonomous motivation, which is in turn a key determinant of engagement in learning. Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation complements this view by proposing that motivation operates at global, contextual, and situational levels, and that contextual factors specific to a given domain of activity — such as the feedback students receive during PE coursework — shape contextual motivation, which in turn cascades down to situational engagement in specific learning tasks. Pedagogical feedback, when perceived as informational rather than controlling, has been identified as a major lever supporting the sense of competence and, through it, autonomous motivation (Hattie & Timperley, 2007). This informational function of feedback has since been confirmed specifically within PE: a systematic review of feedback effects on motor skill learning concluded that descriptive, progress-oriented feedback consistently outperforms purely evaluative feedback in supporting PE learners (Zhou, De Shao, & Wang, 2021), while broader evidence on teachers' interpersonal behavior in PE similarly links supportive, informational styles to better learning outcomes (Tian & Shen, 2023).

Engagement itself is best understood as a multidimensional construct encompassing behavioral, cognitive, and emotional components, to which more recent work has added an agentic dimension reflecting students' proactive contribution to their own learning conditions (Fredricks, Blumenfeld, & Paris, 2004; Reeve, 2012; Reeve & Tseng, 2011). A recent conceptual refinement of the construct has further clarified this multidimensionality, distinguishing learning engagement from broader school engagement and addressing longstanding concerns of definitional overlap across the behavioral, cognitive, emotional, and agentic dimensions (Wong & Liem, 2022). This multidimensionality is theoretically important for the present study: it is precisely because engagement captures observable participation, sustained attention, and self-regulated effort — rather than a purely internal motivational state — that it is theorized to be the construct most proximal to perceived competency development, downstream from motivation itself.

In parallel, self-efficacy theory (Bandura, 1997) suggests that students' prior sport experience constitutes a source of mastery experiences likely to strengthen their engagement in physical activities, independently of its effect on motivation. This primacy of mastery experience among the sources of self-efficacy has recently received renewed empirical support

outside the PE context, in a study ranking the relative importance of Bandura's four sources of self-efficacy for physical activity and confirming mastery experience as the strongest predictor (Egele, Klopp, & Stark, 2025). Unlike feedback, which is a contextual factor delivered by the teacher within the training program, prior sport experience is a personal, biographical resource that students bring with them into training. Theoretically, these two predictors are therefore expected to operate through partially different pathways: feedback should act primarily through the motivational route described by self-determination theory, whereas sport experience should act more directly on engagement through the mastery-based mechanisms described by self-efficacy theory and by Harter's (1978) competence motivation framework.

Within the Moroccan and broader Maghreb context, research specifically addressing PE teacher training remains comparatively limited, although a growing body of work is beginning to fill this gap. Recent Moroccan research on the motivational dimension of PE has noted that empirical studies on the motivational dynamics of PE students remain scarce and scattered, despite increasing scholarly interest in the topic (Moumen & Koutaya, 2026). Direct evidence on the professional competencies of Moroccan PE student teachers points in a similar direction: an observational study of second-year PE trainees at the Faculty of Education Sciences in Rabat found only limited mastery of core professional competencies — didactic knowledge, communication, lesson planning, and learning management — highlighting a persistent gap between training objectives and trainees' actual classroom-ready skills (Mousmi, 2026). In neighboring Tunisia, the introduction of the LMD (Licence-Master-Doctorat) reform into PE teacher training institutes has similarly been described as a largely top-down process, implemented with limited empirical grounding in the realities of trainees' experience (Fraj, Desbiens, & Bali, 2023), and even the measurement of engagement itself among Maghrebi PE and sport students has only recently been placed on solid psychometric footing, with the first Arabic-language validation of a university student engagement inventory carried out on a large Tunisian PE and sport student sample (Tannoubi et al., 2023). Taken together, this regional literature underscores both the relevance and the timeliness of empirically grounded research into the psychological and experiential factors that shape competency development among Maghrebi PE trainees — a gap the present study seeks to help address.

Despite the richness of these theoretical frameworks, few studies have simultaneously tested the mediating role of motivation and engagement in the relationship between, on the one hand, pedagogical feedback and prior sport experience, and on the other hand, the development of perceived competencies in PE. A systematic review of the broader relationship between perceived teacher support and student engagement in PE confirmed a significant positive association across the available literature, while also noting that the underlying mediating mechanisms remain insufficiently tested (Guo et al., 2023). The closest antecedents to the present design come from two very recent studies among Chinese college PE students, which modeled teacher support as acting on engagement through self-efficacy and autonomous motivation (Guo et al., 2025) or through self-

efficacy and sport task orientation (Xu, Tan, Abdullah, & Baker, 2025). While these studies confirm that support-type variables operate on PE engagement through sequential psychological mechanisms, neither examined pre-service PE teachers specifically, neither combined a contextual predictor (feedback) with a biographical predictor (prior sport experience) within the same serial model, and neither tested motivation and engagement — as conceptually distinct from self-efficacy or task orientation — as sequential mediators. Existing research has, more broadly, often examined pedagogical feedback and prior sport experience separately, or has modeled motivation and engagement as parallel rather than sequential mediators, which limits the ability to test whether motivation is a necessary step toward engagement or whether the two constructs are independently associated with the effects of distal predictors. Moreover, this question has rarely been addressed within the specific population of PE teacher trainees, whose profile — combining formal academic training with often extensive personal sporting backgrounds — makes the relative contribution of pedagogical versus experiential factors a particularly relevant empirical question.

The present study aims to address this gap by testing a serial mediation model among undergraduate PE students, in which pedagogical feedback and prior sport experience are modeled as distal predictors, motivation and engagement as sequential mediators, and the development of perceived competencies in physical education as the outcome. Based on this theoretical framework, the following hypotheses were formulated:

H1: Pedagogical feedback positively predicts students' motivation.

H2: Prior sport experience positively predicts students' motivation and engagement.

H3: Motivation positively predicts engagement.

H4: Motivation and engagement serially mediate the association between (a) pedagogical feedback, (b) prior sport experience, and the development of perceived competencies in physical education.

Materials and Methods

Participants

The target population consisted of students enrolled in the Bachelor's degree program in Physical Education and Sport (Year 1 to Year 3) at the École Normale Supérieure of Martil, affiliated with Abdelmalek Essaâdi University. The actual number of students enrolled and actively pursuing their PE-BA training for the 2025–2026 academic year was 632 (Year 1: $n = 176$; Year 2: $n = 258$; Year 3: $n = 198$). The questionnaire, distributed electronically with the agreement of the department's academic coordinators, collected 261 responses, corresponding to a response rate of 41.3%. After data cleaning (see Results), the final analyzed sample comprised $N = 248$ PE undergraduate students (Year 1: $n = 91$; Year 2: $n = 92$; Year 3: $n = 65$; 125 males, 123 females).

Study Design

A cross-sectional survey design was used. A non-probability convenience sampling method was applied: the

questionnaire was distributed electronically (Google Forms) to students, with the agreement of the relevant academic coordinators, between March and July 2026. Participation was voluntary and anonymous.

Procedures and Instruments

The questionnaire included a profile section (age, sex, year of study, regular sport practice, prior competition participation, practice frequency) followed by five scales of eight items each, measuring respectively motivation, perceived pedagogical feedback, engagement, prior sport experience, and perceived competency development in physical education. All five scales are self-report measures: they capture students' own perceptions and self-assessments rather than externally observed or objectively assessed behaviors or skills. In particular, the outcome variable — referred to throughout as “competencies” for brevity in tables and figures — reflects students' perceived or self-reported development of competencies, not an observer-rated or performance-based assessment of actual motor or pedagogical competence; this terminology is used consistently throughout the manuscript. Each item was rated on a five-point Likert scale (1 = Strongly disagree; 5 = Strongly agree).

Data were collected via an online form. An information notice specified the scientific purpose of the study, the anonymous nature of the responses, and their strictly academic use. Participants' consent was implicit upon submission of the form, consistent with usual practice for minimal-risk, non-interventional surveys in educational science.

Because the data are cross-sectional and self-reported, all statistical relationships reported in this manuscript — including regression coefficients, correlations, and indirect/direct paths in the mediation models — are interpreted as associations rather than as evidence of causal influence. Terms such as “predictor,” “indirect effect,” and “direct effect” are used in their standard statistical sense, as conventionally defined in the mediation analysis literature (Hayes, 2018), and do not imply a causally verified sequence of events.

Instrument Development

The five scales were developed specifically for this study rather than adapted from previously validated instruments. Item generation was guided by the theoretical frameworks described in the Introduction: self-determination theory (Deci & Ryan, 1985, 2000) for the motivation scale, with items addressing interest, enjoyment, effort, and persistence; the feedback literature (Hattie & Timperley, 2007) for the pedagogical feedback scale, with items addressing the frequency, clarity, and perceived usefulness of teacher feedback; multidimensional engagement models (Fredricks, Blumenfeld, & Paris, 2004; Reeve, 2012) for the engagement scale, with items addressing behavioral participation, attention, and initiative; self-efficacy theory (Bandura, 1997) for the sport experience scale, with items addressing prior mastery experiences and their perceived transfer to PE learning; and general competency-development frameworks in PE teacher education for the outcome scale, with items addressing technical, reflective, and self-

regulatory competencies. This item-generation, review, and pilot-testing sequence follows the early stages of established scale-development guidelines for the health, social, and behavioral sciences (Boateng, Neilands, Frongillo, Melgar-Quinonez, & Young, 2018), although, as noted in the Limitations, the later psychometric stages of that framework (exploratory/confirmatory factor analysis, independent expert content-validity indexing) were not conducted for the present instrument. The initial item pool was reviewed by the co-authors and the first author's doctoral supervisor for clarity, relevance, and alignment with the intended theoretical dimensions, and items identified as ambiguous or redundant were revised accordingly. The revised questionnaire was then piloted with a small group of PE students who did not take part in the main study, to check item comprehension, wording, and completion time; minor wording adjustments were made based on this pilot feedback before the questionnaire was distributed to the full sample. The complete item set for all five scales, in their original French version and in English translation, is provided in the Appendix as supplementary material.

Statistical Analysis

The analyses were conducted in several steps: (1) data cleaning and verification of response consistency; (2) calculation of internal consistency (Cronbach's alpha) for each of the five scales; (3) calculation of composite scores (mean of items) and descriptive statistics; (4) Pearson correlation analysis among the five constructs; (5) testing of a serial mediation model via successive regressions on standardized variables, following established recommendations for regression-based mediation analysis (Hayes, 2018), with bootstrap estimation (5,000 resamples, 95% percentile confidence intervals) of indirect effects (Preacher & Hayes, 2008), tested separately for each of the two distal predictors (pedagogical feedback, sport experience); (6) complementary analyses (ANOVA, t-tests) to explore the effect of profile variables. All analyses were performed in Python (pandas, pingouin, and statsmodels libraries).

Results

Participants and Data Cleaning Procedure

The initial sample comprised 261 responses. Thirteen responses (5.0%) showed inconsistent multiple selections on the categorical profile variables (age, year of study, or practice frequency), likely due to a form artifact, and were excluded. The final analyzed sample comprised $N = 248$ PE undergraduate students (Year 1: $n = 91$; Year 2: $n = 92$; Year 3: $n = 65$; 125 males, 123 females). All items across the five 8-item scales (motivation, pedagogical feedback, engagement, sport experience, competency development) were set as mandatory fields in the online form; consequently, no missing data occurred on any of these 40 items in the final analytic sample of $N = 248$.

A chi-square goodness-of-fit test was conducted to verify the representativeness of the final sample relative to the actual distribution of the 632 students enrolled in the PE-BA program for the 2025–2026 academic year (Year 1: 27.8%; Year 2: 40.8%; Year 3: 31.3%). This test revealed a significant discrepancy between the observed distribution in the sample

(36.7% / 37.1% / 26.2%) and the expected distribution, $\chi^2_{(2)} = 9.89$, $p = .007$, with Year 1 being overrepresented and Year 3 underrepresented. This limitation is discussed further below.

Table 1. Sample distribution by year of study relative to the reference population

Year	Population (%)	Sample (%)	Sample n
Year 1	27.8	36.7	91
Year 2	40.8	37.1	92
Year 3	31.3	26.2	65

Note. $\chi^2_{(2)} = 9.89$, $p = .007$. Reference population: 632 students enrolled in the PE-BA program, 2025–2026 academic year.

Reliability and Descriptive Statistics

Internal consistency for each of the five scales (8 items, 1–5 Likert format) proved excellent, with Cronbach's alpha coefficients all above .91 (Table 2). Because a very high alpha can itself signal item redundancy rather than pure reliability (Taber, 2018), this uniformly high internal consistency is interpreted with appropriate caution alongside the other psychometric indicators reported below. The distributions show pronounced negative skewness across all scales, indicating a ceiling effect (overall high scores), which is noted as a methodological limitation.

Table 2. Descriptive statistics and internal consistency of the five scales

Scale	M	SD	Skewness	Cronbach's α	95% CI
Motivation	4.23	0.76	-1.66	.926	[.912, .939]
Pedagogical feedback	3.92	0.76	-0.82	.915	[.898, .930]
Engagement	4.18	0.72	-1.46	.915	[.898, .930]
Sport experience	4.14	0.79	-1.46	.931	[.917, .943]
Competencies	4.04	0.78	-1.44	.934	[.921, .946]

Note. M = mean; SD = standard deviation; scale from 1 to 5. $n = 248$.

Correlations Among Constructs

All correlations among the five constructs were positive and significant (Table 3), with coefficients ranging from .689 to .844, confirming the existence of associations sufficiently strong to justify a mediation model.

Table 3. Correlations among the five constructs

Variable	1	2	3	4	5
1. Motivation	—				
2. Feedback	.738**	—			
3. Engagement	.826**	.786**	—		
4. Sport experience	.740**	.689**	.809**	—	
5. Competencies	.764**	.772**	.844**	.844**	—

Note. ** $p < .001$. $n = 248$.

Table 4. Serial mediation model — pedagogical feedback as distal predictor

Effect	β	p	95% Bootstrap CI
Direct effect: Feedback $\rightarrow$ Motivation (a_1)	.738	< .001	—
Direct effect: Feedback $\rightarrow$ Engagement (a_2)	.387	< .001	—
Direct effect: Motivation $\rightarrow$ Engagement (d_{21})	.540	< .001	—
Direct effect: Motivation $\rightarrow$ Competencies (b_1)	.142	.017	—
Direct effect: Engagement $\rightarrow$ Competencies (b_2)	.530	< .001	—
Residual direct effect: Feedback $\rightarrow$ Competencies (c')	.251	< .001	—
Total effect: Feedback $\rightarrow$ Competencies (c)	.772	< .001	—
Indirect via Motivation only	.105	—	[.007, .212]
Indirect via Engagement only	.205	—	[.125, .290]
Serial indirect (Motivation $\rightarrow$ Engagement)	.211	—	[.134, .300]
Total indirect	.521	—	[.395, .640]

Note. Standardized coefficients (β). CI = bootstrap confidence interval (5,000 resamples, percentile method). $n = 248$.

Table 5. Serial mediation model — prior sport experience as distal predictor

Effect	β	p	95% Bootstrap CI
Direct effect: Experience $\rightarrow$ Motivation (a_1)	.740	< .001	—
Direct effect: Experience $\rightarrow$ Engagement (a_2)	.436	< .001	—
Direct effect: Motivation $\rightarrow$ Engagement (d_{21})	.504	< .001	—
Direct effect: Motivation $\rightarrow$ Competencies (b_1)	.111	.038	—
Direct effect: Engagement $\rightarrow$ Competencies (b_2)	.393	< .001	—
Residual direct effect: Experience $\rightarrow$ Competencies (c')	.444	< .001	—
Total effect: Experience $\rightarrow$ Competencies (c)	.844	< .001	—
Indirect via Motivation only	.082	—	[-.013, .184] (n.s.)
Indirect via Engagement only	.171	—	[.095, .262]
Serial indirect (Motivation $\rightarrow$ Engagement)	.147	—	[.078, .219]
Total indirect	.400	—	[.284, .518]

Note. n.s. = not significant (the confidence interval includes zero). $n = 248$.

Serial Mediation Model — Pedagogical Feedback

A first serial mediation model (Pedagogical feedback $\rightarrow$ Motivation $\rightarrow$ Engagement $\rightarrow$ Competencies) was tested via successive OLS regressions on standardized variables, with bootstrap estimation (5,000 resamples, 95% percentile confidence intervals) of the indirect effects (Table 4). All three indirect pathways were statistically significant, as was the residual direct association, consistent with partial mediation: a substantial proportion of the total association between pedagogical feedback and perceived competency development (67%, .521/.772) was statistically accounted for by motivation and engagement jointly.

Serial Mediation Model — Prior Sport Experience

A second model tested prior sport experience as the distal predictor (Table 5). The indirect association via motivation alone was not significant (the interval includes zero), but the indirect associations via engagement alone and via the full serial pathway were significant, as was the residual direct association (partial mediation, 47% of the total association).

Complementary Analyses

Group comparisons enriched the interpretation of the model. No significant difference was observed according to year of study (Year 1/2/3) on any of the five constructs (Table 6), suggesting that these variables do not progress linearly across the curriculum as measured here. Similarly, regular sport practice (yes/no) and sex showed no significant differences. By contrast, prior competition participation significantly distinguished students on all five constructs, with a medium effect size, following Cohen's (1988) conventional benchmarks, for perceived sport experience ($d = 0.59$) and for competencies ($d = 0.41$) (Table 6).

Summary of Hypotheses

H1 (Feedback $\rightarrow$ Motivation): confirmed. H2 (Sport experience $\rightarrow$ Motivation and Engagement): confirmed. H3 (Motivation $\rightarrow$ Engagement): confirmed. H4 (mediation via Motivation and Engagement): confirmed for both predictors, with partial mediation in both cases and a significant serial pathway. However, the mediation via motivation alone was not significant for sport experience, which qualifies H4 for this specific predictor.

Table 6. Differences by year of study, prior competition participation, and regular sport practice

Year of Study (one-way ANOVA)					
Variable	Year 1 (M)	Year 2 (M)	Year 3 (M)	F(2, 245)	p
Motivation	4.25	4.22	4.22	0.04	.966
Feedback	3.99	3.82	3.95	1.21	.300
Engagement	4.21	4.17	4.15	0.17	.842
Sport experience	4.15	4.12	4.14	0.05	.951
Competencies	4.08	3.96	4.10	0.77	.462
Prior Competition Participation (independent-samples t-test)					
Variable	M Yes	M No	t	p	Cohen's d
Motivation	4.30	4.09	2.016	.046	0.27
Feedback	3.96	3.82	1.406	.161	0.18
Engagement	4.27	4.00	2.743	.007	0.37
Sport experience	4.28	3.84	4.335	< .001	0.59
Competencies	4.15	3.84	3.136	.002	0.41
Regular Sport Practice (independent-samples t-test)					
Variable	M Yes	M No	t	p	Cohen's d
Motivation	4.23	4.23	0.006	.995	0.00
Feedback	3.93	3.82	0.757	.453	0.15
Engagement	4.20	4.05	1.089	.281	0.21
Sport experience	4.17	3.97	1.326	.191	0.25
Competencies	4.07	3.90	1.139	.260	0.22

Note. $n = 248$. Effect sizes (Cohen's d) interpreted following Cohen's (1988) conventional benchmarks (small = 0.20, medium = 0.50, large = 0.80).

Discussion

The aim of this study was to test a serial mediation model examining how motivation and engagement statistically account for the association between, on one hand, pedagogical feedback and prior sport experience, and on the other hand, the development of perceived competencies in physical education. Overall, the results are consistent with this model and offer three main contributions to the literature on PE teacher training: (1) they clarify the motivational pathway associated with feedback in relation to perceived learning, (2) they reveal that prior sport experience follows a partially different pattern of association from that of feedback, being more closely linked to engagement than to motivation, and (3) they show that the variable most strongly associated with students' profiles is not seniority in the program but prior competitive experience. As the data are cross-sectional and self-reported, all interpretations below describe patterns of statistical association rather than demonstrated causal processes.

The Pivotal Role of Pedagogical Feedback

Consistent with H1, perceived pedagogical feedback was strongly associated with students' motivation ($\beta = .738$). This result is consistent with self-determination theory (Deci & Ryan, 1985, 2000; Ryan & Deci, 2020), which posits that informational feedback — perceived as support for progress rather than as judgment — nurtures the psychological need for competence, theorized as a driver of autonomous

motivation. It also aligns with Hattie and Timperley's (2007) review describing feedback as one of the most robust pedagogical correlates of learning in the educational science literature, as well as with extensions of this framework to the specific context of physical education (Ntoumanis, 2001), where the motivational climate established by the teacher has been associated with students' investment.

The specific contribution of the present study is to show that this association is not limited to a direct feedback-motivation link: two-thirds of the total association between feedback and perceived competency development (67%) was statistically accounted for by the motivation-engagement chain. This pattern suggests that the association between feedback quality and students' self-reported competencies may operate largely through their motivation, which is in turn linked to greater self-reported engagement in learning tasks — although this sequential interpretation reflects the structure of the theoretical model tested and cannot be confirmed as a causal sequence given the cross-sectional design (see Limitations). This result is nonetheless consistent with the idea, often stated in general terms in the literature, that feedback may be more closely tied to an indirect than to a direct correlate of self-reported motor learning.

A Distinct Pattern of Association for Prior Sport Experience

The second model tested reveals a more nuanced pattern. Although prior sport experience was significantly associated with motivation ($\beta = .740$) and engagement ($\beta = .436$),

consistent with H2, the indirect association estimated via motivation alone did not reach significance (95% CI = [-.013, .184]), unlike what was observed for feedback. This result invites a distinction between two theoretical explanations that are conceptually close but distinct: self-determination theory, relevant for interpreting the association involving feedback, and Bandura's (1997) self-efficacy theory, more relevant for interpreting that involving sport experience. Students with a richer sporting background were not necessarily more motivated to learn, but reported higher engagement, a pattern consistent with the possibility that mastery experiences accumulated through sport may be associated with engagement independently of motivation. This distinction is consistent with Harter's (1978) work on competence motivation, which proposes that a sense of mastery can be linked to behavioral engagement independently of the initial motivational state.

This differentiation between the two distal predictors constitutes one of the most original contributions of the study: it suggests that motivation and engagement, although strongly correlated ($r = .826$), are not simple proxies for one another but are associated with partially distinct antecedents — a distinction that parallel mediation models, more common in the literature, might have obscured.

Engagement as the Central Proximal Mediator

In both models tested, engagement was the mediator most strongly associated with perceived competency development ($\beta = .530$ for the feedback model; $\beta = .393$ for the sport experience model), more so than motivation itself ($\beta = .142$ and $.111$, respectively). This result is consistent with contemporary models of academic and sport engagement (Reeve, 2012; Reeve & Tseng, 2011), which describe engagement — behavioral, cognitive, and agentic — as the construct most proximally linked to effective learning in theoretical accounts of the motivational process. In the present data, motivation alone was not sufficient: engagement — reflected in active participation, sustained attention, and persistence in the task — showed the stronger association with perceived competency development. This pattern of associations (motivation linked to engagement, which in turn is more strongly associated with perceived competencies, rather than motivation relating to competencies directly) suggests a pedagogical implication, developed further below: training programs may benefit from explicitly targeting engagement behaviors, and not only the desire to learn.

Unexpected Findings That Enrich the Interpretation

Two unanticipated findings deserve detailed discussion. First, the absence of any significant difference between Year 1, Year 2, and Year 3 students on the five constructs is surprising given the implicit assumption of curricular progression. This pattern is, however, less isolated than it might first appear: recent observational research on pre-service PE teachers likewise found only minimal differences in teaching competencies across cohorts, concluding that initial teacher education contexts may not substantially enhance pedagogical competence throughout the degree (Mellado-Berenguer & Monfort-Pañego, 2026), and a

related study similarly found that teaching efficacy among pre-service PE teachers was shaped more by accumulated teaching experience than by year level per se (Salin et al., 2025). Several interpretations are possible. It may be that PE training, as currently structured, is not differentially associated with motivation or engagement across years — in which case this finding directly calls into question the pedagogical design of the curriculum. It is also possible that cohort effects (classes that otherwise differ) mask a genuine progression effect, or that the cross-sectional design fails to capture change that occurs more at the intra-individual level than between year groups. Only a longitudinal follow-up of the same students across the three years would allow these hypotheses to be disentangled.

Second, prior participation in sport competitions proved to be the most discriminating profile variable, with effect sizes ranging from small to medium across constructs ($d = .18$ to $.59$), whereas regular sport practice — although conceptually close — showed no significant difference. This contrast suggests that perceived competency development in PE may be more closely associated with the qualitatively specific nature of competitive experience than with the frequency of physical practice per se: exposure to performance pressure, social evaluation of skill level, and the structured technical coaching characteristic of competitive sport. This distinction between recreational and competitive practice, rarely made in the literature on PE teacher training, offers a useful avenue for refining the diagnostic criteria used to identify support needs at entry into training.

Theoretical Contribution and Positioning

Taken as a whole, this study extends the existing literature in three respects. On a theoretical level, it proposes an empirical articulation between self-determination theory and self-efficacy theory within a single model, showing that these two frameworks are associated with distinct patterns of association depending on the nature of the predictor (contextual/pedagogical for SDT, experiential/personal for self-efficacy). This articulation is particularly meaningful in a teacher-training population, since self-efficacy beliefs formed during initial training are widely regarded as a distinct and especially consequential construct compared with self-efficacy in other domains, given their documented links to teachers' persistence, instructional behavior, and career-long professional engagement (Tschannen-Moran & Woolfolk Hoy, 2001). On a methodological level, the use of a serial mediation model, rather than a simple correlational analysis or multiple regression, makes it possible to document not only that these variables are related, but the sequential pattern of association among them that is consistent with the proposed theoretical model — while acknowledging that causal order cannot be established with cross-sectional data (see Limitations). Finally, on an applied level, it provides concrete, hierarchized levers for reflection for PE teacher training, discussed below.

Limitations

Several limitations should be considered when interpreting these findings, and each has direct implications for how the results should be read. First, and most

importantly, the cross-sectional design does not allow causal relationships between variables to be established. All associations reported — including the direct, indirect, and total paths in the two mediation models — describe patterns of statistical association among variables measured at a single point in time. The sequence postulated in the theoretical model (feedback/experience → motivation → engagement → competencies) reflects the order suggested by theory and was used to structure the regression equations, but it remains a working hypothesis rather than a demonstrated causal chain: the same data pattern would be equally consistent with alternative orderings (for example, engagement reinforcing motivation over time, or perceived competency development itself reinforcing engagement) that a cross-sectional design cannot rule out. Readers, and the authors themselves in the interpretation offered above, should therefore treat terms such as “mediation,” “indirect association,” and “pathway” as descriptions of a statistical model consistent with theory, not as evidence that one variable causally produced change in another. Only an experimental or longitudinal design could adjudicate between competing causal orderings. Second, all five constructs were measured through student self-report, which introduces at least two distinct concerns. The first is social desirability bias — a distortion documented even for ostensibly non-sensitive constructs such as physical activity and lifestyle habits in large survey samples (Teh et al., 2023) — reinforced by the pronounced negative skewness (ceiling effect) observed across all five scales, which may have compressed the observed correlations and attenuated the ability to detect weaker associations. The second concern is a shared-method artifact: because all constructs were measured with the same self-report format at the same time, part of the observed associations among motivation, engagement, feedback, and perceived competencies may reflect common method variance rather than substantive association. Neither concern can be fully ruled out with the present design, and both underscore why the outcome variable is described throughout as “perceived” or “self-reported” competency development rather than as an objective, observer-rated, or performance-based measure of motor or pedagogical competence. Third, the sample shows a representativeness imbalance by year of study, with Year 1 overrepresented and Year 3 underrepresented relative to the actual population ($\chi^2 = 9.89, p = .007$). This raises the possibility of differential non-response bias — for example, if students who felt more or less engaged in their training were differentially likely to respond depending on their year of study. This concern is partly, though not fully, mitigated by the absence of a significant difference between years on any of the five constructs (Table 6), which suggests that the imbalance is unlikely to have systematically distorted the associations reported in the main mediation models. Fourth, the sample was drawn from a single institution (the École Normale Supérieure of Martil), which limits the generalizability of the findings to other PE teacher training programs, particularly those with different admission criteria, curricula, or national contexts. A multi-site replication, ideally spanning several Moroccan or Maghrebi institutions, would be needed to assess whether the pattern of associations observed here holds more broadly. Fifth, although the five measurement scales were grounded in established theoretical frameworks and reviewed by the co-authors and doctoral supervisor

prior to piloting (see Instrument Development), they have not yet undergone a formal psychometric validation beyond internal consistency testing: no exploratory or confirmatory factor analysis was conducted to verify the intended factor structure, and no independent expert content-validity index was computed. While internal consistency was excellent for all five scales ($\alpha > .91$), this means that factorial and convergent validity have not yet been formally established. Future use of these scales should include such validation steps. The complete item set is provided in the Appendix to allow readers and future researchers to evaluate, refine, and further validate them.

Pedagogical and Institutional Implications

If corroborated by future longitudinal or experimental research, these results would argue for strengthening PE teacher training in the practice of constructive, individualized feedback centered on progress rather than solely on evaluation, rather than for simply extending the duration of training. Structured teacher-training programs designed to increase autonomy-supportive, informational feedback have already demonstrated feasibility and effectiveness with in-service PE teachers (Cheon, Reeve, & Moon, 2012), and a comparable module embedded within PE teacher education curricula could plausibly extend similar benefits to pre-service teachers themselves. Since engagement was the mediator most strongly associated with perceived competency development in the present model, trainers may also benefit from designing activities that explicitly call for active participation, sustained attention, and student initiative, rather than limiting themselves to interventions aimed solely at fostering motivation or interest. Finally, since it is prior competitive experience, rather than year of study or regular practice, that was most clearly associated with students' profiles, an entry-level diagnostic specifically addressing students' competitive background could help target differentiated support — particularly technical confidence-building programs for students without competitive experience — rather than standardized content by year of study.

Future Research Directions

Three extensions appear particularly promising. A longitudinal design, following the same cohort of students from Year 1 to Year 3, would help resolve the question of actual competency progression across the curriculum, which the cross-sectional design of the present study cannot settle. A mixed-methods approach, combining self-assessment with observational measures of actual motor competencies, would reduce the risk of social desirability and shared-method bias identified above. Finally, a replication of the tested model in other PE teacher training institutions, in Morocco or in other national contexts, would help assess the generalizability of the distinction observed between the motivational (feedback) and experiential (sport competition) correlates of perceived competency development.

Conclusions

This study set out to test whether motivation and engagement serially mediate the association between

pedagogical feedback and prior sport experience, on one hand, and the development of perceived competencies in physical education among pre-service PE teachers, on the other. The results are consistent with all four hypotheses: pedagogical feedback and prior sport experience were both associated with motivation and engagement, motivation was associated with engagement, and the two constructs jointly and partially accounted for the association between both distal predictors and perceived competency development (67% and 47% of the total association, respectively). Engagement, rather than motivation, was the mediator most strongly associated with perceived competency development, and the pattern linking sport experience to the outcome operated largely independently of motivation, consistent with a self-efficacy rather than a self-determination account. As the design is cross-sectional and all measures are self-reported, these findings should be read as a coherent pattern of statistical association consistent with the proposed theoretical model, not as demonstrated causal pathways. With this caveat in mind, the findings speak to the study's purpose by clarifying how feedback and prior sport experience are associated with perceived competency gains through a sequential pattern involving motivation and engagement, and they lend support to prioritizing feedback quality and engagement-oriented teaching practices, together with differentiated support based on students' competitive background, in PE teacher training programs.

Ethics Approval

This study involved an anonymous, voluntary, minimal-risk online survey of enrolled university students, with no experimental manipulation and no collection of identifying or sensitive personal data. In accordance with the institution's policy for this category of minimal-risk, non-interventional educational research, formal approval from an institutional ethics committee was not required. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Informed Consent

An information notice preceding the online questionnaire specified the scientific purpose of the study, the anonymous nature of the responses, and their strictly academic use. Participants' informed consent was obtained implicitly upon voluntary submission of the questionnaire, consistent with standard practice for minimal-risk, non-interventional surveys in educational science. As all participants were enrolled Bachelor's-degree university students, parental/guardian consent was not applicable.

Data Availability Statement

The data supporting the findings of this study are available from the authors upon reasonable request.

AI Transparency Statement

The authors used AI-assisted tools (Claude, Anthropic) for spelling and grammar correction and for language rephrasing during the preparation of this manuscript. The authors reviewed all content and take full responsibility for its scientific accuracy and conclusions.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Appendix: Complete Measurement Scales

All items were rated on a five-point Likert scale (1 = Strongly disagree; 5 = Strongly agree). The original questionnaire was administered in French; the English translations below are provided for the international readership of this journal.

Motivation Scale

1. I am motivated to learn in physical education.
2. I feel enjoyment during physical education practical lessons.
3. I make efforts to progress in physical activities.
4. I am interested in the content taught in physical education.
5. I wish to improve my competencies in physical education.
6. I actively involve myself in practical lessons.
7. I persevere even when tasks are difficult.
8. I seek to improve my physical performance.

Pedagogical Feedback Scale

1. The teacher provides regular feedback during physical education lessons.
2. The feedback I receive helps me improve my performance.

3. The corrections given are clear and understandable.
4. The teacher effectively guides me in learning motor skills.
5. I understand my mistakes thanks to the explanations given.
6. The feedback is adapted to my level in physical education.
7. The teacher acknowledges and values my progress.
8. The instructions given are precise and useful.

Engagement Scale

1. I actively participate in physical education lessons.
2. I am attentive during practical sessions.
3. I involve myself in the activities proposed.
4. I practice physical activities outside of class.
5. I make consistent efforts to progress.
6. I remain focused during exercises.
7. I take initiative during physical activities.
8. I follow the instructions given by the teacher.

Prior Sport Experience Scale

1. My sport experience facilitates my learning in physical education.

2. My sport practice helps me understand exercises more quickly.
3. My sporting background improves my competencies in physical education.
4. I feel comfortable in the physical activities proposed.
5. I have already acquired technical foundations in sport.
6. My sport experience strengthens my confidence in physical education.
7. I adapt easily to new physical activities.
8. I master several sport-specific motor skills thanks to my experience.

Perceived Competency Development Scale

1. I develop my technical competencies in physical education.
2. I progress in my physical performance.
3. I become more autonomous in physical activities.
4. I better understand the objectives of physical education lessons.
5. I am able to analyze my performance.
6. I correct my mistakes autonomously.
7. I become more competent in sport activities.
8. I develop my learning abilities in physical education.

Детермінанти розвитку компетентності у фізичному вихованні: медіативна роль мотивації та залученості

Хатім Бен Седдік^{1ABCD E}, Хіба Рімі^{2ABCD E}, Самір Ессафі^{2ABCD E}, Ашраф Фікрі^{1ABCD E},
Бадреддін Лабакум^{2ABCD E}, Шаймає Халі^{2ABCD E}, Сулайман Харфуф^{1ABCD E}

¹Університет Абдельмалека Ессааді

²Університет Хасана I

Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 13 с., 6 табл., 32 джерела.

Мета дослідження. У дослідженні протестовано модель послідовної медіації для вивчення того, як педагогічний зворотний зв'язок і попередній спортивний досвід асоційовані з розвитком суб'єктивно сприйманих компетентностей у фізичному вихованні (ФВ) через послідовні медіативні ролі мотивації та залученості.

Матеріали та методи. Учасниками дослідження були 248 студентів бакалаврату (1-й курс: n = 91; 2-й курс: n = 92; 3-й курс: n = 65; 125 осіб чоловічої статі, 123 особи жіночої статі), які навчалися за бакалаврською програмою з фізичного виховання та спорту в Вищій нормальній школі Мартіля (École Normale Supérieure of Martil) Університету Абдельмалека Ессааді, Марокко. Збір даних здійснювали за допомогою онлайн-опитувальника з використанням методу поперечного зрізу, що містив п'ять восьмипунктових шкал Лайкерта для вимірювання мотивації, суб'єктивно сприйманого педагогічного зворотного зв'язку, залученості, попереднього спортивного досвіду та розвитку суб'єктивно сприйманої компетентності; усі дані базувалися на самозвітах учасників. Внутрішня узгодженість була відмінною для всіх шкал (альфа Кронбаха > .91). Дві моделі послідовної медіації було протестовано з використанням бутстреп-вибірки (5000 ітерацій, 95% перцентильні довірчі інтервали).

Результати. Як суб'єктивно сприйманий педагогічний зворотний зв'язок, так і попередній спортивний досвід значущо асоційовані з розвитком суб'єктивно сприйманої компетентності. Ці взаємозв'язки частково пояснювалися мотивацією та залученістю (67% та 47% від загального зв'язку, відповідно). Залученість виявилася медіатором, найбільш сильно асоційованим із розвитком суб'єктивно сприйманої компетентності в обох моделях. Зокрема, непрямий зв'язок через саму лише мотивацію був статистично незначущим для попереднього спортивного досвіду. Не було встановлено суттєвих відмінностей залежно від курсу навчання, тоді як попередній досвід участі у змаганнях значущо корелював з усіма п'ятьма конструктами самозвіту. З огляду на поперечний дизайн дослідження та використання методу самозвіту, ці зв'язки не слід інтерпретувати як причинно-наслідкові.

Висновки. Мотивація та залученість діють як послідовні, частково відокремлені медіатори зв'язку між педагогічним зворотним зв'язком, попереднім спортивним досвідом та розвитком суб'єктивно сприйманої компетентності. Отримані результати мають важливе теоретичне та практичне значення для підготовки викладачів фізичного виховання, зокрема щодо розробки зворотного зв'язку та диференційованої підтримки з урахуванням змагального досвіду студентів.

Ключові слова: залученість, зворотний зв'язок, мотивація, фізичне виховання, самоефективність, послідовна медіація, підготовка викладачів.

Information about the Authors:

Ben Seddik, Hatim: Hatimbenseddik17@gmail.com; <https://orcid.org/0009-0004-5176-9933>; Humanities and Education Research Laboratory, Higher Normal School, Abdelmalek Essaâdi University, Tetouan, Morocco.

Rimy, Hiba: rimy.hiba.doc@uhp.ac.ma; <https://orcid.org/0009-0007-3458-6176>; Sports Science Research Team, Institute of Sports Science, Hassan I University, Settat, Morocco.

Essafi, Samir: essafisamir114@gmail.com; <https://orcid.org/0009-0001-6294-0538>; Sports Science Research Team, Institute of Sports Science, Hassan I University, Settat, Morocco.

Fikri, Achraf: achraffikri15@gmail.com; <https://orcid.org/0009-0001-7597-8922>; Humanities and Education Research Laboratory, Higher Normal School, Abdelmalek Essaâdi University, Tetouan, Morocco.

Labakoum, Badreddine: b.labakoum@uhp.ac.ma; <https://orcid.org/0009-0004-6414-3614>; Energy-Materials-Instrumentation and Telecom Laboratory (EMIT), Faculty of Science and Technology, Hassan I University, Settat, Morocco.

Khali, Chaimae: chaimae.khali@uhp.ac.ma; <https://orcid.org/0009-0003-5790-6516>; Sports Science Research Team, Institute of Sports Science, Hassan I University, Settat, Morocco.

Harfouf, Soulaïman: s.harfouf@uae.ac.ma; <https://orcid.org/0009-0002-3215-2642>; Humanities and Education Research Laboratory, Higher Normal School, Abdelmalek Essaâdi University, Tetouan, Morocco.

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