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From achievement motivation to perceived learning in flipped in-service training: a cross-sectional path analysis among medical sciences staff

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Abstract

Background & Objective: Flipped in-service training has become an important learner-centered approach for supporting professional development in health-related organizations. However, its effectiveness depends not only on instructional design, but also on learners' motivational and self-regulatory characteristics. This study aimed to examine a cross-sectional path model of perceived learning in flipped in-service training among medical sciences staff in Shiraz.

Materials & Methods: This descriptive cross-sectional correlational study included all 140 eligible staff members in the accessible population of Shiraz University of Medical Sciences who had participated in flipped in-service training courses. The path equations were estimated from five observed composite scale scores. Coefficients of determination were calculated for every endogenous variable. Indirect associations were estimated as products of path coefficients and evaluated with 10,000 parametric bootstrap resamples and two-sided percentile 95% confidence intervals.

Results: Achievement motivation explained 3.6% of the variance in cognitive engagement ($R^2 = 0.036$), 11.3% in self-regulation ($R^2 = 0.113$), and 4.2% in goal orientation ($R^2 = 0.042$). The simultaneous perceived-learning equation, including achievement motivation, cognitive engagement, self-regulation, and goal orientation, explained 23.5% of the variance in perceived learning ($R^2 = 0.235$). In the adjusted perceived-learning equation, achievement motivation ($\beta = 0.218$, $p = 0.008$) and goal orientation ($\beta = 0.315$, $p < 0.001$) were independently associated with perceived learning, whereas cognitive engagement and self-regulation were not. Only the indirect association through goal orientation excluded zero (indirect association = 0.064, 95% CI [0.011, 0.131]).

Conclusion: Achievement motivation and goal orientation showed independent associations with perceived learning, and the only supported model-based indirect association was through goal orientation. These cross-sectional coefficients describe covariance and do not establish temporal order or causal effects.

Keywords: flipped classroom; perceived learning; achievement motivation; cognitive engagement; goal orientation; self-regulation

Introduction

Continuing professional development and in-service training are important for maintaining the knowledge, skills, and adaptive capacity of health-related workforces. Staff in medical sciences organizations must continuously update their competencies while managing professional workload, organizational demands, and evolving educational technologies. Recent evidence suggests that continuing professional development is most effective when it moves beyond one-way information delivery and adopts flexible, learner-

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centered, and context-sensitive learning approaches [1, 2]. This is especially important in health systems, where learning should support knowledge acquisition, practical application, professional confidence, and performance improvement.

The flipped classroom is among the most discussed learner-centered approaches in health professions education. Learners typically study core materials before the formal session, and class time is devoted to discussion, feedback, problem solving, and application. Systematic reviews and meta-analyses indicate that flipped approaches may enhance academic performance and satisfaction in health professional education, though the evidence varies across contexts, disciplines, and implementation models [3, 4]. A 2025 meta-analysis in medical education also reported better knowledge outcomes and satisfaction with flipped instruction compared with traditional methods, but highlighted substantial heterogeneity and the need to consider contextual and learner-related factors [4].

This variability is significant because flipped learning is not merely a technological substitute for lectures. Its success depends on whether learners prepare beforehand, participate actively, monitor their understanding, and relate new content to prior experience. Evidence from clinical medical education shows that combining flipped methods with case-based learning can improve theoretical scores and clinical analytical skills relative to lecture-based teaching [5]. Similarly, an integrated self-regulated learning and flipped classroom intervention in nursing education improved skills performance, self-efficacy, and self-regulated learning compared with traditional instruction [6]. These findings indicate that flipped education's effectiveness is closely related to motivational and self-regulatory processes.

Perceived learning is a relevant outcome for evaluating flipped in-service training because it reflects learners' own judgment of what they have gained from an educational experience. Although perceived learning should not be treated as a substitute for objective performance, it remains an important educational indicator, especially in adult and continuing education contexts where learners evaluate the usefulness, relevance, and applicability of training to their professional needs. Rovai et al. conceptualized perceived learning across cognitive, affective, and psychomotor domains, making it suitable for evaluating educational experiences that involve knowledge acquisition, learner attitudes, and practical application [7]. Recent research in online learning has also linked academic motivation and engagement with learners' perceived learning, supporting the need to examine perceived learning in relation to psychological and behavioral learning factors [8].

Achievement motivation is one of the central learner-related factors in flipped in-service training. In flipped in-service training, learners must take responsibility for pre-session preparation and active participation. Therefore, learners with stronger achievement motivation may be more willing to invest effort, persist in challenging tasks, and use training opportunities to improve their performance. In medical education, motivation has been linked with self-regulation and academic outcomes, suggesting that motivated learners are more likely to organize their learning behaviors and sustain effort during demanding educational tasks [9]. However, the association between motivation and perceived learning may also involve other learner-related processes, including cognitive engagement, goal orientation, and self-regulation. It may also operate through mediating processes such as cognitive engagement, goal orientation, and self-regulation.

Self-regulation is particularly important in flipped and blended learning environments. Learners need to plan their study, monitor their comprehension, manage time, seek help when needed, and regulate effort across pre-class and in-class activities. A recent systematic review of self-regulated learning strategies in blended higher education showed that such strategies are important for improving learning processes and outcomes [10]. In flipped in-service training, self-regulation may be even more critical because participants are working adults who must balance training requirements with professional responsibilities. Without self-regulation, the preparatory phase of flipped learning may remain superficial, limiting the effectiveness of subsequent interactive activities.

Cognitive engagement also plays an important role in explaining perceived learning. It refers to the mental investment learners make in understanding, elaborating, organizing, and applying educational content. In flipped learning, cognitive engagement is the process through which pre-session materials are transformed into meaningful understanding during discussion, problem solving, and practice. Li and Lajoie argued that cognitive engagement and self-regulated learning are closely interconnected, because effective learners do not merely participate behaviorally; they actively monitor, adapt, and deepen their cognitive processing during learning [11]. Accordingly, cognitive engagement may function

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as an important pathway between achievement motivation and perceived learning.

Goal orientation is another psychological factor that may shape how learners experience flipped in-service training. Learners with stronger mastery-oriented goals are more likely to focus on understanding, improvement, and skill development, while those with performance-oriented goals may be more focused on external evaluation or comparison with others. Recent evidence has shown that achievement goals are associated with academic engagement and performance, with self-regulated learning strategies acting as an important mediating mechanism [12]. In flipped training, goal orientation may be related to whether learners approach preparatory tasks and classroom activities as opportunities for professional growth or merely as formal training requirements.

Despite the growing body of research on flipped classroom approaches in health professions education, three gaps remain. First, most studies have focused on students rather than medical sciences staff engaged in continuing professional development. Second, the literature has largely compared flipped and traditional instruction, with less attention to psychological mechanisms associated with perceived learning. Third, cognitive engagement, self-regulation, and goal orientation have seldom been estimated simultaneously, making it difficult to examine their distinct pathways while accounting for their conceptual overlap. The present study addresses these gaps by estimating the direct and indirect associations between achievement motivation and perceived learning through the three proposed intermediate pathways in one model. This simultaneous model offers a theoretical comparison of unique pathways, but the cross-sectional design provides correlational—not causal—evidence. Its practical value is to identify candidate correlates that can be prioritized in subsequent longitudinal and experimental studies.

In the present model, cognitive engagement, self-regulation, and goal orientation were treated as distinct but interrelated mechanisms. Cognitive engagement refers to the mental investment learners make in understanding, elaborating, and applying instructional content. Self-regulation refers to how learners plan, monitor, and adjust their learning processes across pre-session and in-session activities. Goal orientation refers to the motivational purpose that directs effort toward mastery, performance, or avoidance of failure. These three constructs are conceptually related but distinct. Cognitive engagement and self-regulation overlap because monitoring and strategy use can deepen processing; goal orientation also overlaps with both because goals organize effort and influence strategy selection [11, 12]. Their simultaneous inclusion therefore permits comparison of cognitive, regulatory, and goal-related pathways within a single model. Nevertheless, they are not interchangeable: they respectively represent depth of processing, management of the learning process, and motivational direction. The proposed path model is shown in **Figure 1**.

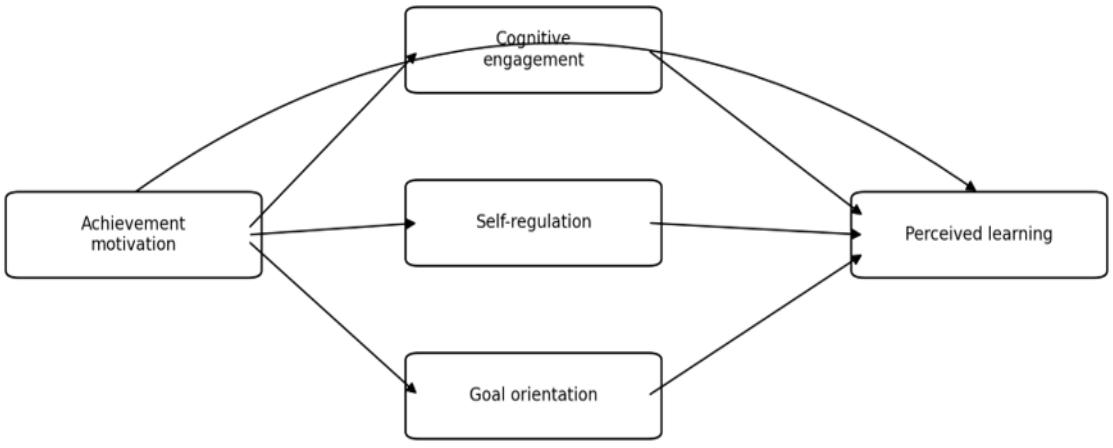

Figure 1. Proposed path model of the relationships among study variables

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Materials & Methods

Design and setting(s)

This study used a descriptive cross-sectional correlational design and was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for observational studies [13]. The study was conducted among staff of Shiraz University of Medical Sciences who participated in flipped in-service training courses. In the flipped training format, instructional content was provided before the training session, while the formal session was used for interaction, clarification, and applied learning activities.

The study was conducted from 1 September 2025 to 30 November 2025.

Participants and sampling

The target population comprised staff of Shiraz University of Medical Sciences who were employed by the organization and had participated in flipped in-service training during the study period. Administrative participation records identified an accessible population of 140 eligible staff members; this number does not represent all employees of the university. Because the accessible population was limited, all 140 eligible staff members were invited by census. All invitees returned questionnaires and all questionnaires were retained for analysis, yielding a final sample of 140 and a response rate of 100%.

Tools/Instruments

Data were collected using a demographic information form and five previously developed instruments assessing achievement motivation, self-regulation, goal orientation, perceived learning, and cognitive engagement. Achievement motivation was assessed using the Inventory of School Motivation, developed within the personal investment framework [14]. In the present study, the questionnaire contained 43 items and assessed four higher-order motivational orientations: ability orientation, performance orientation, social goal orientation, and external goal orientation. Items were scored on a 5-point Likert scale. Total scores could range from 43 to 215, with higher scores indicating stronger achievement motivation. The questionnaire had no reverse-scored items. In the present study, content validity was assessed by 10 academic experts, and the content validity ratio was acceptable. Cronbach's alpha values were 0.75 for ability orientation, 0.80 for performance orientation, 0.78 for social goal orientation, 0.70 for external goal orientation, and 0.75 for the total scale.

Self-regulation was measured using the 14-item Bouffard self-regulation questionnaire [15]. The scale included two dimensions: cognitive strategies and metacognitive strategies, each consisting of seven items. Items were scored on a 5-point Likert scale ranging from 1 to 5. Items 5, 13, and 14 were reverse-scored. Total scores could range from 14 to 70, with higher scores indicating greater use of self-regulatory strategies. In the present study, content validity was confirmed by 10 academic experts. Cronbach's alpha values were 0.70 for the cognitive dimension and 0.75 for the metacognitive dimension. Goal orientation was evaluated using the academic goal orientation questionnaire developed by Bouffard et al. [16]. The questionnaire contained 20 items and measured three dimensions: mastery goal orientation, performance goal orientation, and failure-avoidance goal orientation. The mastery dimension included six items, while the performance and failure-avoidance dimensions each included seven items. Items were scored on a 5-point Likert scale from 1 to 5. Total scores could range from 20 to 100, with higher scores indicating stronger goal orientation. In the present study, the content validity ratio was acceptable based on expert review. Cronbach's alpha values were 0.75 for mastery goal orientation, 0.80 for performance goal orientation, and 0.75 for failure-avoidance goal orientation.

Perceived learning was measured using the perceived learning scale developed by Rovai et al. [7]. In the present study, the instrument consisted of 12 items scored on a 5-point Likert scale from 1 to 5. The questionnaire generated a total score and did not include separate subscales.

Higher scores indicated higher perceived learning in the flipped in-service training context. Content validity was evaluated by 10 academic experts, and the content validity ratio was acceptable. Cronbach's alpha for the scale was 0.75 in the present study. Cognitive engagement was measured using the cognitive engagement questionnaire attributed to Wang and Eccles [17]. The questionnaire consisted of five items scored on a 5-point Likert scale. Higher scores indicated greater cognitive investment in learning activities, including effortful processing, attention to learning tasks, and the use of learning strategies. The instrument was selected because cognitive engagement is theoretically aligned with the active learning requirements of flipped instruction. Cronbach's alpha for the scale was 0.81 in the present sample.

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Data collection methods

After the necessary administrative arrangements had been completed, the questionnaires were distributed to eligible staff members who had participated in flipped in-service training courses. Participants were informed about the purpose of the study, the voluntary nature of participation, and the confidentiality of their responses. The questionnaires were completed individually and checked for completeness before analysis.

Data analysis

Descriptive statistics and Pearson correlations were obtained using SPSS version 24. The path model was then estimated from the reported 5 × 5 Pearson correlation matrix of the five observed composite scale scores using regression-equivalent path equations in Python 3.12. The 94 questionnaire items were not entered as 94 separate indicators, and an item-level confirmatory factor analysis was not conducted. Achievement motivation was specified as the exogenous variable; cognitive engagement, self-regulation, and goal orientation were each regressed on achievement motivation; and perceived learning was regressed simultaneously on achievement motivation and the three proposed mediators. Because census sampling fixed the maximum sample at 140, an approximate power and sensitivity calculation was reported rather than used to determine recruitment. With n = 140, four predictors, $\alpha = 0.05$, and a medium effect size ($f^2 = 0.15$), power based on the noncentral F distribution was 0.966. At 80% power, the smallest detectable overall effect was approximately $f^2 = 0.088$. Thus, the analysis was well powered for a medium overall effect but had limited sensitivity to small coefficients and indirect associations. Univariate distributions were screened using skewness and kurtosis, and multicollinearity was assessed using tolerance and variance inflation factor statistics. Absolute skewness below 3 and kurtosis below 10 were used as broad screening criteria. KMO and Bartlett statistics were also calculated from the 5 × 5 correlation matrix of the composite scores as descriptive diagnostics of score-level factorability. The KMO value was 0.690, and Bartlett's test was statistically significant, $\chi^2(10, n = 140) = 80.04$, $p < 0.001$. These statistics were not used as prerequisites for the path analysis, and no item-level confirmatory factor analysis was performed. For each endogenous variable, the coefficient of determination (R^2) was calculated as the squared multiple correlation from its specified regression equation. Standardized indirect associations were estimated by the product-of-coefficients method (a × b). Their uncertainty was evaluated with a reproducible parametric bootstrap: 10,000 samples of n = 140 were drawn from a multivariate normal distribution defined by the reported composite-score correlation matrix (random seed = 2812), all path equations were re-estimated in each sample, and two-sided percentile 95% confidence intervals were obtained from the empirical distribution of each product. An indirect association was considered statistically supported when its 95% interval excluded zero. Because the item-level response matrix was not available, Harman's single-factor test could not be performed. This potential common-method limitation is acknowledged in the Discussion.

Results

A total of 140 staff members of Shiraz University of Medical Sciences participated in the study. As shown in **Table 1**, most participants were male (n = 89, 63.57%), while 51 participants were female (36.43%). Regarding marital status, 97 participants were single (69.28%) and 43 were married (30.71%). In terms of educational level, the largest groups were participants with a master's degree (n = 60, 42.85%) and those with a doctorate or medical degree (n = 59, 42.15%), whereas 21 participants had a bachelor's degree (15.00%).

Table 1. Characteristics of the participants (n = 140)

Variable	Category	n	%
Gender	Male	89	63.57
Gender	Female	51	36.43
Marital status	Single	97	69.28
Marital status	Married	43	30.71
Educational level	Bachelor's degree	21	15.00
Educational level	Master's degree	60	42.85
Educational level	Doctorate/medical degree	59	42.15
Age (years)	Mean ± SD	40.62 ± 7.17	—
Work experience (years)	Mean ± SD	10.73 ± 6.15	—

Note: Descriptive statistics were used to summarize demographic and background characteristics. Age and work experience are presented as continuous variables (mean ± standard deviation) as recommended.
Abbreviations: n, number of participants; SD, standard deviation.

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As shown in **Table 2**, the mean score of perceived learning was 30.27 ± 3.63. The mean score of cognitive engagement was 13.24 ± 2.62. Regarding self-regulation, the total mean score was 38.85 ± 4.66, with mean scores of 20.35 ± 3.24 for the cognitive strategy dimension and 18.66 ± 4.05 for the metacognitive strategy dimension. The total mean score of goal orientation was 63.83 ± 9.01. Among its dimensions, mastery goal orientation had a mean score of 27.12 ± 4.63, performance goal orientation had a mean score of 19.99 ± 4.22, and failure-avoidance goal orientation had a mean score of 23.74 ± 4.80. The mean score of achievement motivation was 109.87 ± 9.68.

As shown in **Table 3**, the correlation matrix summarizes the bivariate relationships among the study variables. Pearson correlation analysis was conducted to examine bivariate relationships among the study variables. The strongest correlation with perceived learning was observed for goal orientation ($r = 0.401$, $p < 0.01$), followed by achievement motivation ($r = 0.327$, $p < 0.01$), self-regulation ($r = 0.251$, $p < 0.01$), and cognitive engagement ($r = 0.212$, $p < 0.05$). Achievement motivation was correlated with self-regulation ($r = 0.336$, $p < 0.01$), goal orientation ($r = 0.204$, $p < 0.05$), and cognitive engagement ($r = 0.189$, $p < 0.05$). Goal orientation was also correlated with cognitive engagement ($r = 0.320$, $p < 0.01$) and self-regulation ($r = 0.227$, $p < 0.01$). The association between self-regulation and cognitive engagement was positive but not statistically significant ($r = 0.110$, $p = 0.196$).

Table 2. Descriptive statistics of the study variables

Variable	n	Mean	SD	Possible range	Observed range	Skewness	Kurtosis
Achievement motivation	140	109.87	9.68	43–215	92–148	1.49	1.74
Self-regulation	140	38.85	4.66	14–70	26–55	1.21	1.14
Goal orientation	140	63.83	9.01	20–100	36–79	1.01	1.35
Cognitive engagement	140	13.24	2.62	5–25	10–17	0.75	1.75
Perceived learning	140	30.27	3.63	12–60	20–38	0.89	1.25

Note: Descriptive statistics including mean, standard deviation, skewness, and kurtosis were calculated for each variable.
Abbreviations: n, number of participants; SD, standard deviation.

Table 3. Correlations among study variables

Variable	1	2	3	4	5
1. Achievement motivation	—				
2. Self-regulation	0.336**	—			
3. Goal orientation	0.204*	0.227**	—		
4. Perceived learning	0.327**	0.251**	0.401**	—	
5. Cognitive engagement	0.189*	0.110	0.320**	0.212*	—

Note: Values are Pearson correlation coefficients. *p < 0.05; **p < 0.01.
Abbreviations: r, Pearson correlation coefficient; p, probability value.

Before estimating the path model, score distributions and multicollinearity diagnostics were examined. As reported in **Table 2**, skewness ranged from 0.75 for cognitive engagement to 1.49 for achievement motivation, whereas kurtosis ranged from 1.14 for self-regulation to 1.75 for cognitive engagement. All values were within the prespecified screening limits. Tolerance and variance inflation factor statistics did not indicate problematic multicollinearity. **Table 4** reports the coefficient of determination for every endogenous variable. Achievement motivation explained 3.6% of the variance in cognitive engagement ($R^2 = 0.036$), 11.3% in self-regulation ($R^2 = 0.113$), and 4.2% in goal orientation ($R^2 = 0.042$). The simultaneous equation containing achievement motivation, cognitive engagement, self-regulation, and goal orientation explained 23.5% of the variance in perceived learning ($R^2 = 0.235$). Thus, explained variance was relatively small for cognitive engagement and goal orientation, modest for self-regulation, and moderate for perceived learning.

Table 4. Coefficients of determination for endogenous variables

Endogenous variable	Predictor(s)	R^2	Variance explained
Cognitive engagement	Achievement motivation	0.036	3.6%
Self-regulation	Achievement motivation	0.113	11.3%
Goal orientation	Achievement motivation	0.042	4.2%
Perceived learning	Achievement motivation, cognitive engagement, self-regulation, and goal orientation	0.235	23.5%

Note: R^2 represents the coefficient of determination for each endogenous variable.
Abbreviation: R^2, coefficient of determination.

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As presented in **Table 5**, achievement motivation was positively associated with cognitive engagement (β = 0.189, p = 0.025), self-regulation (β = 0.336, p < 0.001), and goal orientation (β = 0.204, p = 0.016). In the simultaneous perceived-learning equation, achievement motivation retained an independent association with perceived learning (β = 0.218, p = 0.008).

Among the three proposed mediators, only goal orientation showed an independent association with perceived learning after simultaneous adjustment (β = 0.315, p < 0.001). The adjusted coefficients for cognitive engagement (β = 0.059, p = 0.463) and self-regulation (β = 0.100, p = 0.221) were not statistically significant. These adjusted results differ from the corresponding bivariate correlations because the perceived-learning equation estimates the unique association of each predictor while holding the others constant. The 10,000-resample parametric bootstrap results are shown in **Table 6**. The indirect association through goal orientation was 0.064 (bootstrap SE = 0.031, 95% CI [0.011, 0.131]), and its percentile interval excluded zero. The indirect associations through cognitive engagement and self-regulation had confidence intervals that included zero.

The indirect associations through cognitive engagement (.011, 95% CI [−0.019, 0.051], p = 0.481) and self-regulation (.034, 95% CI [−0.020, 0.097], p = 0.213) were not statistically supported because their intervals included zero. Accordingly, the data supported one model-based indirect association—through goal orientation—while the weaker products involving cognitive engagement and self-regulation remained uncertain. Given the cross-sectional design, even the supported product represents a statistical decomposition of covariance rather than evidence of temporal mediation.

Table 5. Direct path coefficients of the proposed model

Path	Standardized coefficient (β)	Unstandardized coefficient (B)	SE (B)	t-value	p-value	Result
Achievement motivation to Cognitive engagement	0.189	0.051	0.023	2.26	0.025	Statistically significant
Achievement motivation to Self-regulation	0.336	0.162	0.039	4.19	< 0.001	Statistically significant
Achievement motivation to Goal orientation	0.204	0.190	0.078	2.45	0.016	Statistically significant
Achievement motivation to Perceived learning	0.218	0.082	0.031	2.68	0.008	Statistically significant
Goal orientation to Perceived learning	0.315	0.127	0.033	3.86	< 0.001	Statistically significant
Cognitive engagement to Perceived learning	0.059	0.082	0.111	0.74	0.463	Not statistically significant
Self-regulation to Perceived learning	0.100	0.078	0.063	1.23	0.221	Not statistically significant

Note: All path coefficients were estimated using regression-equivalent path equations. Statistically significant paths are indicated where p < 0.05.
Abbreviations: β, standardized coefficient; B, unstandardized coefficient; SE, standard error; p, probability value.

Table 6. Parametric bootstrap results for indirect associations with perceived learning

Indirect path	Indirect association	Bootstrap SE	p-value	95% CI lower	95% CI upper	Result
Achievement motivation to Cognitive engagement to Perceived learning	0.011	0.017	0.481	− 0.019	0.051	Not statistically significant
Achievement motivation to Goal orientation to Perceived learning	0.064	0.031	0.014	0.011	0.131	Statistically significant
Achievement motivation to Self-regulation to Perceived learning	0.034	0.029	0.213	− 0.020	0.097	Not statistically significant

Note: CI = confidence interval. Indirect associations were estimated as products of standardized path coefficients. The table reports two-sided percentile 95% intervals from 10,000 parametric bootstrap samples of n = 140 generated from the reported composite-score correlation matrix (random seed = 2812).
Abbreviations: CI, confidence interval; SE, standard error.

Discussion

This study examined a cross-sectional path model of perceived learning in flipped in-service training among medical sciences staff. Achievement motivation was positively associated with cognitive engagement, self-regulation, goal orientation, and perceived learning. When the perceived-learning equation included all four predictors simultaneously, achievement motivation and goal orientation retained independent associations, whereas cognitive engagement and self-regulation did not. Of the three proposed indirect pathways, only the pathway through goal orientation had a 95% bootstrap

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interval that excluded zero. These results describe adjusted and indirect associations, not causal effects.

The positive association between achievement motivation and perceived learning is consistent with the nature of flipped in-service training. In flipped training, learners are expected to prepare before the formal session and then participate actively in discussion, clarification, and applied learning activities. This structure places greater responsibility on learners for their own learning process. Staff with stronger achievement motivation may therefore be more likely to engage with pre-session materials, persist when learning is demanding, and use the training session for deeper understanding. Recent evidence from online and technology-supported learning also shows that academic motivation and psychological engagement are related to perceived learning performance [8]. Similarly, research on online learning environments has indicated that learning motivation plays an important mediating role in learners' engagement [18]. These findings are consistent with the interpretation that achievement motivation is a relevant learner-related factor in flipped in-service training.

Cognitive engagement showed a positive bivariate correlation with perceived learning, but its adjusted path coefficient was small and not statistically significant after achievement motivation, self-regulation, and goal orientation were entered simultaneously. This attenuation may reflect shared variance with the other learner characteristics, particularly goal orientation, rather than a clearly separable independent association in this sample. Prior literature still identifies cognitive engagement as relevant to learning processes [8, 18], but the present data do not support a distinct adjusted or indirect association for cognitive engagement.

Self-regulation was positively correlated with perceived learning, but its unique adjusted coefficient and its indirect product were not statistically supported. This result does not show that self-regulation is unimportant; with n = 140, the precision of a weak unique association may be insufficient to distinguish it reliably from zero when correlated predictors are entered simultaneously. Studies of flipped nursing and blended education have reported associations or intervention-related changes in self-regulated learning [6, 19], but those designs, populations, and outcomes differ from the present cross-sectional self-report analysis.

Goal orientation showed the largest adjusted coefficient for perceived learning among the three proposed mediators, and its indirect product with achievement motivation was the only one whose bootstrap interval excluded zero. This pattern suggests that how learners define success may be related to how they appraise their learning. Recent evidence has shown that achievement goals are associated with academic engagement and performance, with self-regulated learning strategies accounting for part of that relationship [12]. In the present cross-sectional data, however, the indirect coefficient is a model-based association and does not demonstrate that achievement motivation temporally changed goal orientation or that goal orientation caused greater perceived learning.

Although the present findings indicated significant associations among achievement motivation, cognitive engagement, self-regulation, goal orientation, and perceived learning, previous studies have not shown consistently strong or significant relationships across different engagement dimensions and learning outcomes. Navarro et al. [21], in a structural model involving 301 university students in virtual education, found that behavioral engagement was not significantly associated with perceived learning ($\beta = 0.035$, $p = 0.840$). They also reported that cognitive engagement ($\beta = -.164$, $p = 0.301$) and emotional engagement ($\beta = 0.001$, $p = 0.991$) did not significantly predict academic performance, although cognitive and emotional engagement were associated with perceived learning. In medical education, Chowdhury et al. [22] reported that flipped learning improved students' satisfaction and engagement, but did not produce a significant change in in-course assessment scores. Similarly, Bouwmeester et al. [23] found that medical students in a flipped classroom reported higher self-efficacy immediately after the course, whereas no differences between flipped and traditional classroom groups were observed in knowledge retention or self-efficacy ten months later. These mixed findings suggest that the strength and significance of associations involving motivation, engagement, and learning may depend on the type of learning outcome, the timing of measurement, learner characteristics, and the quality of flipped-learning implementation. Unlike studies that assessed objective examination scores or long-term knowledge retention, the present study examined perceived learning among employed medical sciences staff. Therefore, the positive associations observed in this study should not be generalized as evidence of equivalent improvements in objective achievement, knowledge retention, or workplace performance.

The indirect-path analysis provided a more differentiated account than the bivariate correlations. Only the product through goal orientation was statistically supported; the

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products through cognitive engagement and self-regulation had confidence intervals that included zero. This pattern is compatible with literature relating motivational and regulatory processes to perceived learning [20], but it should be treated as hypothesis-generating. Because temporal order was not observed, none of the indirect coefficients constitutes evidence of mediation in a causal or longitudinal sense.

From a practical perspective, the findings identify several candidates for future evaluation in flipped in-service training: concise pre-session materials linked to workplace tasks; applied activities, case discussions, and reflective tasks; clear learning goals; and self-monitoring supports such as checklists, guiding questions, formative quizzes, and feedback. The present associations do not demonstrate that these strategies improve learning. Their effects should be tested prospectively against objective learning, retention, transfer, and workplace-performance outcomes.

The study has several limitations. First, the cross-sectional design provides no evidence of temporal precedence and does not support causal interpretation of direct or indirect paths. Second, all variables were self-reported at one time point, creating risks of common-method and social desirability bias. The item-level response matrix was not retained in the available analytic archive, so Harman's single-factor test or a more informative marker-variable or latent common-method analysis could not be performed; common-method variance therefore remains an unresolved alternative explanation. Third, the single-center census limits generalizability beyond the accessible group. Fourth, although the model used five composite scores rather than 94 item-level indicators, n = 140 still limits the precision and stability of weak and indirect coefficients. Indirect associations are products of two estimated paths and can be especially unstable in modest samples; the wide intervals around the cognitive-engagement and self-regulation products illustrate this uncertainty. The parametric bootstrap provides an estimate of uncertainty for the indirect associations but relies on multivariate-normal sampling from the reported summary correlation matrix and cannot reproduce case-level non-normality. The power calculation indicated good sensitivity to a medium overall effect but less sensitivity to small unique coefficients, increasing the possibility of Type II error for weaker paths. Fifth, perceived learning is not a substitute for objective achievement, knowledge retention, transfer of training, or workplace performance. Larger, multisite samples with retained item- and case-level data and longitudinal or experimental designs with objective outcomes are needed.

Conclusion

Perceived learning in flipped in-service training among medical sciences staff was associated with learner characteristics, but the adjusted pattern was more selective than the bivariate correlations. Achievement motivation and goal orientation retained independent associations with perceived learning, whereas cognitive engagement and self-regulation did not. The only model-based indirect association with a 95% confidence interval excluding zero was through goal orientation. These coefficients describe the specified covariance pattern and do not establish temporal or causal mechanisms.

Staff who reported greater achievement motivation and goal orientation also reported greater perceived learning after simultaneous adjustment. These associations can inform hypotheses about relevant learner processes, but they do not demonstrate that changing achievement motivation, goal orientation, or any feature of flipped instruction will improve learning. Structured preparation, clear goals, engaging activities, and self-monitoring supports may be evaluated prospectively, but their effects on perceived and objective learning require longitudinal, quasi-experimental, or randomized evidence.

Ethical considerations

This study was approved by the Research Ethics Committee of Payame Noor University (Approval ID: IR.PNU.REC.1404.852). Data collection commenced only after formal ethical approval had been obtained. Participation was voluntary, participants were informed about the study objectives and confidentiality of their responses, and informed consent was obtained before questionnaire completion.

Artificial intelligence utilization for article writing

ChatGPT (OpenAI) was used to assist with language editing during manuscript revision. The authors remain responsible for verifying all scientific content, statistical results, references, and the final manuscript.

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Conflict of interest statement

The authors declare no conflict of interest.

Author contributions

MHS: Conceptualization, supervision, and writing—review and editing. FR: Data curation, formal analysis, and writing—original draft. MN: Methodology, validation, and writing—review and editing. All authors read and approved the final manuscript and accept accountability for the work.

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Data availability statement

The data analyzed in this study are available from the corresponding author upon reasonable request, subject to ethics and confidentiality requirements.

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