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Academic engagement as a mediator between growth mindset and deep learning among prospective teachers

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Research Article

Keywords: growth mindset, academic engagement, deep learning, prospective teachers, mediation, teacher education

Posted Date: September 7th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10923626/v1

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Additional Declarations: No competing interests reported.

Abstract

Background: Growth mindset and academic engagement are important for meaningful learning, yet their relationship with deep learning among prospective teachers remains insufficiently understood.

Purpose: This study examined whether academic engagement mediates the relationship between growth mindset and deep learning.

Methods: A quantitative correlational design was used with 412 prospective teachers aged 18–22 years. Data were collected using researcher-developed measures of growth mindset, academic engagement, and deep learning. Pearson correlations, regression analyses, and path analysis using AMOS 25 examined the proposed mediation model.

Results: Growth mindset positively predicted academic engagement and deep learning, while academic engagement positively predicted deep learning. Academic engagement also significantly mediated the relationship between growth mindset and deep learning, indicating direct and indirect effects.

Conclusion: Growth mindset contributes to deep learning both directly and through enhanced academic engagement. The findings highlight the importance of fostering growth-oriented beliefs and active engagement in teacher education.

1. Introduction

Education in the present era is witnessing rapid transformations imposed by successive cognitive and technological changes. Attention has become directed towards building educational experiences that go beyond the transfer and preservation of knowledge to developing the learner's ability to understand, think, interact, and effectively benefit from educational experiences. The success of the educational process is no longer linked to what the learner acquires in terms of knowledge and information only, but has also become linked to their ability to engage in the learning process, face its challenges, and continuously develop their abilities. In this context, the importance of paying attention to the psychological and educational factors that shape the learner's educational experience emerges, including their beliefs about their ability to develop, the level of their academic engagement, and the nature of the learning they achieve. These factors may contribute to moving learning from an emphasis on memorization and information retention toward deeper, more conscious, and more effective learning.

Academic engagement is an important variable in explaining learners' interaction with educational environments. It is not limited to learners' attendance and participation in educational activities but extends to include behavioral, cognitive, emotional, and social dimensions that reflect the nature of their interaction with the requirements of learning and with those around them. From this perspective, understanding academic engagement requires moving beyond viewing it as an isolated individual behavior and considering it a dynamic phenomenon that develops within social relationships, educational frameworks, and shared experiences that learners live through and interact with (Kahu, 2013; Shernoff et al., 2016; Alivernini et al., 2019).

Understanding academic engagement is also important for alleviating dissatisfaction, preventing boredom, enhancing motivation, and improving academic performance (Freda et al., 2021). Deepening prospective teachers' understanding of engagement is particularly important for enriching their educational experience, especially among those who may experience psychosocial vulnerabilities (Martinot et al., 2022). Moreover, the social

dimension constitutes an important component of academic engagement, as the relationships learners establish with their peers and faculty can provide a supportive environment for sharing resources, ideas, and experiences and can foster a sense of belonging to the learning community (Cavicchiolo et al., 2019a; Girelli et al., 2019). Social interaction with peers may also contribute to enhancing learner motivation and adaptability to the demands of diverse learning environments (Cavicchiolo et al., 2019b).

Academic engagement is also related to learners' beliefs about their abilities and learning potential. Learners do not engage in academic situations and activities independently of how they perceive their abilities and potential for development. Their readiness to persevere, face challenges, benefit from feedback, and seek help may be influenced by their beliefs about whether their abilities can change and develop. In this context, growth mindset represents an important belief that may be associated with academic engagement because it is based on the assumption that abilities and personal qualities can be developed through effort, trying new strategies, learning from mistakes, and seeking help (Dweck & Yeager, 2019; Yeager & Dweck, 2020).

Accordingly, a learner who adopts a growth mindset may be more willing to engage in academic experiences and meet their demands because they perceive difficulties and setbacks as opportunities for learning and development rather than as fixed evidence of their limitations (Zhu et al., 2026). Conversely, a fixed mindset, which is based on the belief that personal traits and abilities are relatively unchangeable, may lead learners to interpret difficulties and failures as indicators of their limitations and may consequently be associated with self-doubt, weak coping strategies, and an increased sense of inadequacy (Kneeland et al., 2016; Mueller et al., 2017; Schroder et al., 2019; Mullarkey & Schleider, 2020).

Despite growing research on growth mindset and academic engagement, limited attention has been given to the mechanisms through which growth mindset may influence the quality of learning among prospective teachers. In particular, it remains unclear whether academic engagement mediates the relationship between learners’ beliefs in the developability of their abilities and deep learning. Accordingly, the present study examines the mediating role of academic engagement in the relationship between growth mindset and deep learning, assuming that growth-oriented beliefs may foster greater academic engagement, which, in turn, may facilitate deeper learning characterized by understanding, analysis, application, integration, and reflection. By examining these relationships simultaneously, the study seeks to clarify the psychological and educational processes through which learners’ beliefs may translate into meaningful academic participation and deeper learning outcomes.

2. Literature Review / Theoretical Framework

2 – 1 Academic Engagement

Academic engagement can be understood as a multidimensional construct reflecting learners' active involvement in their educational experiences. It encompasses behavioral, cognitive, emotional, and social dimensions and therefore extends beyond mere attendance or participation in classroom activities. From this perspective, academic engagement represents a dynamic process through which learners interact with academic tasks, educational environments, teachers, and peers (Kahu, 2013; Shernoff et al., 2016; Alivernini et al., 2019).

The social dimension of academic engagement is particularly important because learners' relationships with peers and faculty can provide opportunities for exchanging resources, ideas, and experiences and can strengthen their sense of belonging within the learning community. Research has indicated that social engagement involves relational interactions through which learners exchange resources and ideas with faculty and peers, thereby

strengthening their integration into the educational experience (Cavicchiolo et al., 2019a; Girelli et al., 2019). Furthermore, social interaction with peers can contribute to enhancing motivation and learners' ability to adapt to the demands of diverse learning environments (Cavicchiolo et al., 2019b).

Academic engagement is also associated with learners' capacity to utilize their social networks and manage relationships within the learning environment. Such capacities may help learners cope with academic difficulties and adapt to academic demands. Conversely, lower engagement may be associated with reduced motivation, decreased participation in learning activities, and less effective use of available social support networks and coping strategies (Abbott-Chapman et al., 2013; Girelli et al., 2018). Relationships with faculty members may similarly contribute to self-regulation and self-motivation, thereby supporting persistence in study and potentially reducing the likelihood of withdrawal from education (Girelli et al., 2018).

2–2 Growth Mindset and Academic Engagement

Growth mindset refers to the belief that abilities and personal qualities can be developed through effort, effective strategies, learning from mistakes, and seeking assistance (Dweck & Yeager, 2019; Yeager & Dweck, 2020). Such beliefs can influence how learners interpret academic challenges and setbacks. Rather than viewing difficulties as evidence of fixed limitations, learners with a growth mindset may interpret them as opportunities to improve and develop (Zhu et al., 2026).

Growth mindset interventions similarly emphasize the developability of personal qualities and abilities and encourage individuals to use effort, experiment with alternative strategies, learn from mistakes, and seek help. This orientation may provide a cognitive and psychological foundation that supports continued engagement with academic demands rather than avoidance or withdrawal (Schleider & Weisz, 2018; Yeager & Dweck, 2020; Zhu et al., 2025).

The relationship between growth mindset and academic engagement can also be understood through learners' responses to challenges. When learners believe that their abilities can develop, they may be more willing to persevere, seek feedback, interact with others, and utilize available academic resources. Conversely, fixed beliefs about ability may make academic difficulties more threatening because failure can be interpreted as evidence of limited ability. Such interpretations may undermine persistence and engagement (Kneeland et al., 2016; Mueller et al., 2017; Schroder et al., 2019; Mullarkey & Schleider, 2020).

A growing body of research has highlighted positive associations between growth mindset and student achievement, engagement, and retention, particularly in STEM contexts (Yeager et al., 2019). Students with stronger growth-oriented beliefs and more positive self-concepts have also been found to report more positive emotions, less boredom, greater knowledge of learning strategies, and better academic performance (Larson, 2023). Similarly, Karlen et al. (2021) found that students with a growth mindset reported more positive emotions and higher academic achievement.

Prevailing beliefs about the fixed nature of abilities have historically been considered an obstacle to achievement and engagement. Dweck (2000) described such beliefs as a "fixed mindset," whereby intelligence and ability are viewed as innate and relatively unchangeable. This perspective may encourage learners to interpret difficulties as evidence of limited competence rather than as opportunities for development, potentially contributing to lower achievement and reduced engagement (Boaler, 2013; Sun, 2015).

In contrast, growth mindset is based on the belief that intelligence and abilities can be developed through effort, effective strategies, and perseverance. Such beliefs have been associated with greater resilience when facing academic challenges and more favorable learning outcomes (Dweck, 2000; Mostafa et al., 2025). Thus, growth mindset may provide learners with a more adaptive interpretation of academic difficulties and increase their readiness to confront challenges rather than interpret them as evidence of limited ability.

2–3 Deep Learning

Deep learning represents an approach to learning that extends beyond information acquisition and retention toward constructing a coherent understanding of knowledge and applying it in new situations. Learners who adopt a deep learning approach tend to focus on understanding and applying information rather than merely memorizing it (Booth et al., 1999). Entwistle et al. (2001) similarly described deep learning as involving substantial learner engagement in the pursuit of knowledge, with an emphasis on understanding, critical reading, purposeful thinking, and connecting prior knowledge with new knowledge.

The distinction between deep and surface learning is also evident in the processes through which learners organize and use information. Surface learning emphasizes memorizing facts and mastering terminology, whereas deep learning emphasizes understanding and establishing relationships among ideas and concepts (Draper, 2009). Tait (2009) further indicated that deep learners tend to connect concepts, apply knowledge to real-life situations, and examine and question conclusions, whereas surface-oriented learners tend to rely on rote memorization and uncritical acceptance of information.

More advanced conceptualizations of deep learning emphasize active cognitive processing, reconstruction of cognitive structures, and the use of cognitive and metacognitive strategies to facilitate knowledge transfer. Ning and Zhu (2016) argued that deep learning depends on prior knowledge, metacognitive processes, and cognitive strategies, making the transfer and application of knowledge to practical problem-solving an important goal.

Deep learning therefore involves not only cognitive processing but also active and conscious engagement in learning. Fox and Anderson (2017) explained that deep learners connect new ideas with prior knowledge, explore underlying principles and models, critically evaluate new ideas and conclusions, and consciously reflect on their learning. Similarly, Zureck (2021) viewed deep learning as a deliberate process that focuses on exploring the essence and significance of learning while developing habits of independent learning through active exploration. Duan (2022) further characterized deep learning as a comprehension-based learning style that enables learners to critically assimilate new knowledge and ideas, integrate them into existing cognitive structures, establish relationships among different ideas, and apply knowledge to new situations involving decision-making and problem-solving.

2–4 Academic Engagement and Deep Learning

Academic engagement represents a potentially important condition for the development of deep learning because deeper learning requires learners to participate actively and consciously in the learning process. Goldspink and Foster (2013) indicated that levels of student participation in learning environments are an important factor in promoting deep learning. Kahu (2013) likewise emphasized the importance of engagement dimensions in understanding learners' educational experiences.

Empirical evidence further suggests that cognitive, affective, and behavioral engagement can contribute to deep learning, knowledge acquisition, and understanding of complex ideas (Chen & Zheng, 2022). From this perspective, academic engagement may facilitate the transition from simply attending educational activities to actively processing, integrating, evaluating, and applying knowledge. Thus, learners who are more behaviorally, emotionally, cognitively, and socially engaged may be more likely to invest the effort and attention required for deeper learning.

2–5 The Mediating Role of Academic Engagement

The relationships discussed above provide a theoretical basis for considering academic engagement as a mediator between growth mindset and deep learning. Growth mindset may influence how learners interpret academic challenges and their own learning potential. When learners believe that their abilities can develop, they may be more willing to exert effort, persevere when difficulties arise, experiment with different strategies, seek feedback, and ask for help (Dweck & Yeager, 2019; Yeager & Dweck, 2020). These behaviors may increase their engagement with academic environments.

Academic engagement, in turn, may provide the behavioral, cognitive, emotional, and social conditions necessary for deeper learning. Active engagement can encourage learners to connect new knowledge with prior knowledge, critically examine ideas, reflect on their learning, and transfer knowledge to new contexts (Goldspink & Foster, 2013; Chen & Zheng, 2022). Consequently, the effect of growth mindset on deep learning may operate, at least partly, through the degree to which learners become actively engaged in their academic environments.

From this perspective, the relationship between growth mindset and deep learning may not be adequately represented by a simple direct association. Instead, growth-oriented beliefs may first influence learners' willingness to participate, persist, interact, and utilize academic resources, while this engagement subsequently contributes to the development of deeper and more meaningful learning. Examining academic engagement as a mediator can therefore help clarify the mechanism through which beliefs about the developability of abilities may be translated into differences in the quality of learning among prospective teachers.

3. Methods

3 – 1 Participants

The current study protocol was approved by the administration of the Faculty of Education in Tafahna Al-Ashraf, Al-Azhar University on 12/7/2026 AD. University students from Al-Azhar University, Faculty of Education, aged (18–22) years participated in the study. The initial sample included 434 prospective teachers. 22 participants were excluded because they reported that they did not want to complete the tests. The final sample consisted of 412 prospective teachers, with an average age of 19.99 years (standard deviation = 1.19). Among the participants, (115) were in the first year (mean age = 18.42 years, standard deviation = (0.33)); (105) were in the second year (mean age = 19.54 years, standard deviation = (0.28)); (102) were in the third year (mean age = 20.53 years, standard deviation = 0.32); and (90) were in the fourth year (mean age = 21.49 years, standard deviation = 0.29). As for the academic specializations, 150 prospective teachers enrolled in the special education program, 80 in the Arabic language program, 70 in the history program, and 52 in the English language program.

3 – 2 Procedures

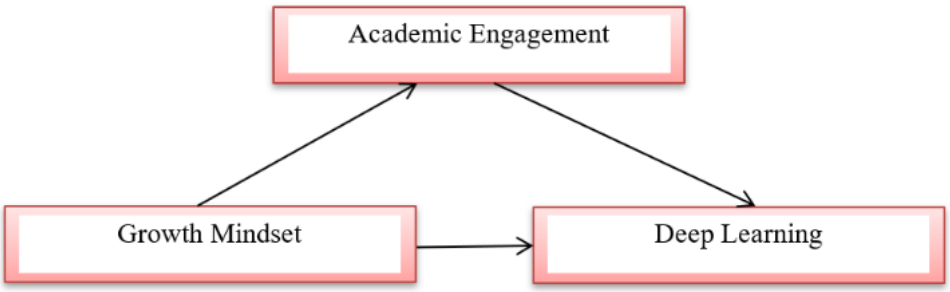
A convenience sample was used to collect data through survey links from July to August 2026. Participants were invited to participate in the electronic survey by completing a Google Forms questionnaire. No incentives were provided. The data collected through the electronic survey were anonymous and were used for statistical purposes only. Written informed consent was obtained from all participants before participation. To reduce the possibility of duplicate responses, each participant's access to the questionnaire was limited to their university identification code. The electronic questionnaire comprised three sections: (1) informed consent and information about data processing; (2) sociodemographic information, including age, year of study, and study program; (3) the Academic Engagement Scale, Growth Mindset Scale, and Deep Learning Scale; The questionnaire was distributed through a link or QR code, and a researcher provided standardized instructions for completion.

3-2-1 Academic Engagement Scale: To define and measure academic engagement, we developed the Academic Engagement Scale, a self-report scale. The scale comprised four dimensions, each with five statements reflecting prospective teachers' academic engagement in the behavioral, affective, cognitive, and interpersonal domains, totaling 20 items. Responses were provided in the form of five multiple-choice options on a five-point Likert scale. Prospective teachers selected one of these options that aligned with their beliefs. The options ranged from (Always) = 5 points, (Often) = 4 points, (Sometimes) = 3 points, (Rarely) = 2 points, and (Never) = 1 point. The total score ranged from 20 to 100 points, with higher scores indicating greater academic engagement. The researchers administered this scale to a pilot sample of 120 prospective teachers, separate from the main study sample. The internal consistency coefficient of this scale was calculated by measuring the correlation coefficient between each dimension and the total score. The scale has the following values: (0.86–0.82–0.79–0.91). The instrument also demonstrated good reliability in our study, with a Cronbach's alpha coefficient of (0.89), reflecting strong internal consistency.

3-2-2 Growth Mindset Scale: To identify and measure growth mindset, we developed a growth mindset scale, a self-report scale. The scale comprised six dimensions, each with five statements reflecting the growth mindset of prospective teachers in the following areas: (motivation, learning behaviors, facing challenges, perseverance and persistence, dealing with difficulties and criticism, and positive thinking). The scale consisted of a total of (30) items, with responses presented as five multiple-choice options on a five-point Likert scale. Prospective teachers selected one of these options that aligned with their beliefs. These options ranged from (always) = 5 points, (often) = 4 points, (sometimes) = 3 points, (rarely) = 2 points, and (never) = 1 point. The total score ranged from 30 to 150 points, with higher scores indicating a stronger growth mindset compared to a fixed mindset. The researchers administered this scale to a pilot sample of (120) students, separate from the main study sample. The instrument was used as a teacher, and the internal consistency coefficient of this scale, through the correlation coefficient of each dimension with the total score of the scale, was as follows: (0.79–0.84–0.83–0.86–0.78–0.89). The instrument also showed good reliability in our study, as Cronbach's alpha coefficient was (0.92), reflecting strong internal consistency.

3-2-3 Deep Learning Scale: To define and measure deep learning, we developed a Deep Learning Scale, a self-reported scale. The scale comprised four dimensions, each with seven items, reflecting the deep learning of prospective teachers in the following areas: (deep understanding and meaning-making, connecting and integrating knowledge, critical thinking and analysis, knowledge transfer and application and problem-solving). The scale consisted of a total of 28 items. Responses were provided in the form of five multiple-choice options on a five-point Likert scale. Prospective teachers selected one of these options that aligned with their beliefs. The options

ranged from (always) = 5 points, (often) = 4 points, (sometimes) = 3 points, (rarely) = 2 points, and (never) = 1 point. The total score ranged from 28 to 140 points, with higher scores indicating a higher level of deep learning compared to superficial learning. The researchers administered this scale to a pilot sample of 120 prospective teachers, separate from the main study sample. The internal consistency of this scale is determined by the correlation coefficient of each dimension with the total score of the scale as follows: (0.79–0.86–0.82–0.89). The instrument also demonstrated good reliability in our study, with a Cronbach's alpha coefficient of (0.91), reflecting strong internal consistency.



Hypothesised model.

3–3 Data analysis

Data analysis was performed using IBM SPSS Statistics version 25, Initially, descriptive statistics (mean and standard deviation) were calculated for the main study variables. No missing data were observed in the final dataset, as the analyses were limited to the completed questionnaires only. Subsequently, the bilateral relationships between the variables were analyzed using Pearson correlation coefficients, given that they are continuous quantitative variables, in accordance with the recommendations for continuous quantitative data (Field, 2018). The aim was to explore the primary correlations between the variables (academic engagement, growth mindset, and deep learning) in order to identify the relationship of academic engagement with both growth mindset and deep learning among prospective teachers. Then, path analysis was used to verify academic engagement as a mediator between growth mindset and deep learning among prospective teachers.

Statistical analyses were carried out using IBM SPSS statistical package version 25. The three regression analyses corresponding to the procedure described by Baron and Kenny (1986) for mediator effects detection were conducted, using the ordinary least squares method, and with the variables entering simultaneously. Subsequently, to obtain a global picture of the relationships between Academic Engagement, Growth Mindset and Deep Learning only those effects that reached statistical significance on the basis of the regression results were brought into the model which was subjected to empirical testing using path analysis. It was calculated with SPSS AMOS (version 25) software by using maximum likelihood as the estimation procedure. The goodness-of-fit of the model was estimated using the chi squared test, the χ 2/df ratio, the comparative fit index (CFI), the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the normed fit index (NFI), and the root mean square error of approximation (RMSEA).

4. Results

The main objective of this study was to assess whether academic engagement mediates the effect of a growth mindset on deep learning. In line with the approach of Baron and Kenny (1986), four regression equations were estimated: (a) growth mindset on deep learning, (b) growth mindset on academic engagement, (c) academic engagement on deep learning, and (d) growth mindset on deep learning through academic engagement. To achieve the mediation hypothesis, academic engagement should emerge as the main predictor of deep learning in the final regression analysis, and the effect of a growth mindset on deep learning should increase.

3-1- H1.The proposed model does not fit well with the path analysis model derived from the research sample results regarding the relationships between academic engagement, growth mindset, and deep learning among prospective teachers.

To verify this hypothesis, the researchers proposed a mediated pathway analysis model using the AMOS program that explains the relationships between the research variables, in light of what had been reviewed in previous studies and research.

Table 1
Pearson correlations between psychological variables.

Descriptive Statistics								**Correlations**		
Variable	N	Mini.	Maxi.	Mean	Std. Devi.	Skew.	Kurt.	Acad. Eng.	Gro. Min.	Deep Lear.
Academic Engagement	412	29.00	109.00	66.145	12.1726	193	.509	-	.480**	.711
Growth Mindset	412	60.00	164.00	122.799	17.26523	− .495	.162	.480**	-	.534**
Deep Learning	412	45.00	133.00	94.3617	12.84145	− .057	.696	.711**	.534**	-
Note. Acad. Eng. = Academic Engagement; Gro. Min.= Growth Mindset; Deep Lear. = Deep Learning;										
** p < 0.01										

The psychological variables showed significant positive correlations with each other.

Academic engagement showed a high correlation with both a growth mindset and deep learning. A growth mindset also showed a high correlation with deep learning.

Based on the above, path analysis was performed on the main research sample, and Figure (1) shows the extracted path analysis model for the relationships between the research variables:

Figure (1) shows the path analysis model extracted for the relationships between the research variables.

Figure 1 clearly shows the direct correlation between academic engagement and the growth mindset and deep learning among prospective teachers.

Table 2 illustrates the indicators of good conformity to the extracted model.

Table 2
Model Fit Summary

S	Model	Index Value	Ideal Range for the Index	Decision
1.	**df (CMIN)**	**1**	**< 5**	**accept**
2.	(RMR)	.00	< 1	accept
3.	(GFI)	.595	< 1	accept
4.	(AGFI)	.190	< 1	accept
5.	(NFI)	.999	< 1	accept
6.	(RFI)	.999	< 1	accept
7.	(IFI)	.989	< 1	accept
8.	(TLI)	.999	< 1	accept
9.	(CFI)	.989	< 1	accept
10.	(RMSEA)	.065	< .08	accept

Table (2) shows that all the values of the good fit indicators for the proposed model came within the acceptable range. According to the above, the null hypothesis is rejected and the alternative hypothesis is accepted, i.e., “there is a good fit between the proposed path analysis model and the research sample data with respect to the causal relationships between academic participation and the growth mindset and deep learning among prospective teachers".

3-2- H2- There is no direct and statistically significant effect of growth mindset on deep learning among prospective teachers.

To verify this hypothesis, direct effects, standard and non-standard regression coefficients, standard error, and the critical value (t-value) and its statistical significance were calculated. Table (3) illustrates the direct pathways between growth mindset and deep learning implied in the pathway analysis model:

Table 3
Direct paths and non-standard and standard regression coefficients for the path analysis model of the growth mindset in deep learning

Variables and direction of influence		**Estimate**	**Standardized Regression Weights**	**S.E.**	**C.R.**	**P**	**Label**
From	**To**						
Growth Mindset	Deep Learning	.186	.250	.028	6.659	***	A
*** Significance level at 0.001							

Table (3) shows that all non-standard and standard regression coefficients had critical values that were statistically significant at the level of (0.001), and the effect was positive and statistically significant between the growth mindset and deep learning. Based on the above, the null hypothesis is rejected and the alternative

hypothesis is accepted, i.e., “there is a direct and statistically significant effect of the growth mindset on deep learning among prospective teachers.”

3-3- H3- There is no direct and statistically significant effect of growth mindset on academic engagement among prospective teachers.

To verify this hypothesis, direct effects, standard and non-standard regression coefficients, standard error, and the critical value equivalent to the value of "t" and its statistical significance were calculated. Table (4) shows the direct paths between the growth mindset in academic participation included in the path analysis model:

Table 4
Direct paths and non-standard and standard regression coefficients for the path analysis model of growth mindset in academic engagement

Variables and direction of influence		Estimate	Standardized Regression Weights	S.E.	C.R.	P	Label
From →	To						
Growth Mindset	Academic Engagement	.338	.480	.031	11.087	***	B
*** Significance level at 0.001							

Table (4) shows that all non-standard and standard regression coefficients had critical values that were statistically significant at the level of (0.001), and the effect was positive and statistically significant between growth mindset and academic participation. Based on the above, the null hypothesis is rejected and the alternative hypothesis is accepted, i.e., “there is a direct and statistically significant effect of growth mindset on academic participation among prospective teachers.”

3-4- H4- There is no direct and statistically significant effect of academic engagement on deep learning among prospective teachers.

To verify this hypothesis, direct effects, standard and non-standard regression coefficients, standard error, and the critical value equivalent to the t-value and its statistical significance were calculated. Table (5) shows the direct paths between academic participation in deep learning included in the path analysis model:

Table 5
Direct Paths and Non-Standard and Standard Regression Coefficients of the Path Analysis Model for Academic Participation in Deep Learning

Variables and direction of influence		Estimate	Standardized Regression Weights	S.E.	C.R.	P	Label
From →	To						
Academic Engagement	Deep Learning	.624	.591	.040	15.746	***	C
*** Significance level at 0.001							

Table (5) shows that all non-standard and standard regression coefficients had critical values that were statistically significant at the level of (0.001), and the effect of academic participation and deep learning was positive and statistically significant. Based on the above, the null hypothesis is rejected and the alternative hypothesis is accepted, i.e., “there is a direct and statistically significant effect of academic participation on the growth mindset of prospective teachers".

3-5- H5- There is no indirect and statistically significant effect of growth mindset on deep learning through academic engagement as a mediating variable among prospective teachers.

To verify this hypothesis, indirect effects and standard and non-standard regression coefficients were calculated. Table (6) illustrates the indirect pathways between growth mindset and deep learning using the path analysis model:

Table 6
Indirect Paths and Standard and Non-Standard Regression Coefficients of the Path Analysis Model for Growth Mindset in Deep Learning through Academic Participation as a Mediating Variable among Prospective teachers

Variables and direction of influence		Estimate	Standardized Regression Weights	Confidence Limits		P
From →	To			Lower	Upper	
Growth Mindset	Deep Learning	.211	.186	.166	.250	0.04**
** Significance level at 0.01						

Table (6) shows that all non-standard and standard regression coefficients had critical values that were statistically significant at the (0.01) level, and the indirect effect was positive and statistically significant for the growth mindset in deep learning through academic participation as a mediating variable among prospective teachers. We note that the confidence limits are in the positive direction for the two values, and this confirms that it is statistically significant. As the mediating role of academic participation is evident, the mediation was partial. Based on the above, the null hypothesis is rejected and the alternative hypothesis is accepted, i.e., “There is an indirect and statistically significant effect of the growth mindset in deep learning through academic participation as a mediating variable among prospective teachers.”

5. Discussion

5 – 1 Path Analysis Model Extracted from Research Sample Results for the Relationship Between Academic Engagement, Growth Mindset, and Deep Learning Among Prospective teachers:

The results of the first hypothesis confirmed that the proposed path analysis model adequately fits the data, supporting its suitability for explaining the relationships among growth mindset, academic engagement, and deep learning among prospective teachers. The model is theoretically consistent with viewing these variables as an interconnected system in which learners’ beliefs about their capacity for development are reflected in their engagement with the academic environment and, consequently, in the quality of their learning. This interpretation is consistent with Kahu (2013), Shernoff et al. (2016), and Alivernini et al. (2019), who emphasized the dynamic and contextual nature of academic engagement and its interaction with personal and environmental factors. The

positive associations among all three variables further support this interconnected framework. Moreover, a growth mindset may encourage students to persist in difficulties, exert effort, use alternative strategies, learn from mistakes, and seek help, thereby promoting academic engagement (Vestad & Bru, 2024), which in turn creates opportunities for the understanding, analysis, integration, and critical examination underlying deep learning (Lester, 2013).

5 – 2 The Direct Impact of a Growth Mindset on Deep Learning Among Prospective teachers:

The results demonstrated a statistically significant direct effect of growth mindset on deep learning among prospective teachers, indicating that students' beliefs about the developability of their abilities are associated with how they approach challenging learning tasks. Consistent with Dweck (2000), a growth mindset encourages learners to interpret effort, persistence, and strategic learning as means of development rather than viewing difficulties or failure as evidence of limited ability. This perspective may promote resilience, engagement in cognitively demanding learning, and more effective knowledge processing. The finding is also consistent with Karlen et al. (2021), who linked growth mindset with more positive academic experiences and achievement, Larson (2023), who found that students with stronger growth mindsets reported greater knowledge of learning strategies, less boredom, and better academic performance.

5 – 3 The Direct Impact of a Growth Mindset on Prospective teachers' Academic Engagement:

The results showed that growth mindset has a significant direct effect on academic engagement among prospective teachers, indicating that beliefs about the developability of abilities can translate into greater persistence, participation, responsiveness to feedback, and help-seeking. From a growth mindset perspective, academic difficulties are viewed as opportunities for development rather than threats to self-worth, encouraging learners to persist, adopt alternative strategies, and remain engaged rather than withdraw. This interpretation is consistent with Schleider and Weisz (2018), and Yeager and Dweck (2020), who emphasized the role of growth-oriented beliefs in promoting persistence through effort, effective strategies, learning from mistakes, and help-seeking. It also aligns with Yeager and Dweck (2020), who reported positive associations between growth mindset and student achievement, engagement, and retention, and with Larson (2023), who linked growth mindset to greater knowledge of learning strategies, more positive emotions, and better academic performance.

5.4 The Direct Impact of Academic Engagement on Deep Learning Among Prospective teachers:

The results showed a statistically significant direct impact of academic engagement on deep learning. This finding is particularly important because academic engagement is not merely a behavior associated with learning, but rather a prerequisite that can support the transition from surface to deep learning.

This result directly aligns with Goldspink and Foster (2013) assertion that student engagement levels in learning environments are a crucial factor in promoting deep learning. It also supports Kahu (2013) view of the importance of engagement in shaping the learning experience, and Chen and Zheng (2022) finding that cognitive, affective,

and behavioral engagement can contribute to deep learning, knowledge acquisition, and the understanding of complex concepts.

This can also be explained by the fact that deep learning requires continuous cognitive activity on the part of the learner. The student cannot build links between new and previous knowledge, reorganize their cognitive structure, examine conclusions, or transfer knowledge to new situations without being actively engaged in the learning process. Hence, academic engagement can be understood as the field in which deep learning processes are practiced. Behavioral engagement gives the student the opportunity to continue performing tasks, cognitive engagement drives them to think about and examine the content, affective engagement increases their interest in the task and their willingness to continue with it, while social engagement allows for the exchange of ideas and experiences with others.

5–5 The Mediating Role of Academic Engagement in the Relationship Between Growth Mindset and Deep Learning Among Prospective teachers:

The result of this hypothesis represents the core of the model proposed in the study. The results revealed a statistically significant indirect effect of growth mindset on deep learning through academic engagement, and that this mediating role was partial. This finding reveals that the relationship between growth mindset and deep learning is more complex than a simple direct effect, as part of the impact of growth mindset is transmitted through what the student actually does within the academic environment.

The intermediate path can be interpreted as the student teacher who believes in the potential for development is more prepared to face academic challenges, exert effort, experiment with different strategies, benefit from feedback, and seek help. These beliefs increase the likelihood of their engagement in the academic environment, whether through participation in activities and discussions, interaction with faculty members and peers, or perseverance in performing tasks. This aligns with the findings of Yeager et al., 2019; Yeager & Dweck, 2020; Larson, 2023). Academic engagement then plays a second role in the path. By providing students with educational and social experiences that enable them to engage in deep learning, students actively participate in the learning environment not only receive information but also have opportunities to discuss, interpret, connect ideas, benefit from feedback, examine conclusions, apply knowledge, and solve problems. This aligns with the findings of Goldspink & Foster (2013), Kahu (2013), and Chen & Zheng (2022), whose studies established a link between academic engagement and deep learning.

Partial mediation is also consistent with the nature of academic engagement itself; it is not merely a psychological result of a growth mindset, but is also shaped by the educational context, social relationships, and shared experiences. Cavicchiolo et al. (2019a) and Girelli et al. (2019) pointed to the role of relationships with faculty members and peers in providing resources, ideas, experiences, and fostering belonging. Girelli et al. (2018) also pointed to the importance of relationships with faculty members in promoting self-regulation, motivation, and continued study. Therefore, the transmission of the growth mindset through participation does not depend on internal belief alone, but rather occurs within the context of an educational environment that provides actual opportunities for participation and interaction.

6. Conclusion

The findings demonstrate an interconnected relationship among growth mindset, academic engagement, and deep learning among prospective teachers. Growth mindset had direct effects on academic engagement and deep

learning, while academic engagement directly predicted deep learning and partially mediated the effect of growth mindset on deep learning. This suggests that believing abilities can develop may promote greater effort, persistence, strategic learning, and responsiveness to feedback, thereby strengthening engagement and facilitating deeper learning. These findings are consistent with Vestad and Bru (2024), who linked teacher support for growth mindset to students' growth mindset and academic engagement, and with Yeager et al. (2019), who associated growth mindset with student engagement and continued learning. Practically, teacher preparation programs should integrate growth-mindset principles, supportive feedback, active learning, collaboration, problem-solving, and reflective activities to strengthen academic engagement as a pathway to deep learning. The partial mediation also highlights the importance of faculty support and the academic environment in translating growth-oriented beliefs into meaningful engagement and learning outcomes.

7. Limitations

The cross-sectional design and reliance on self-report measures limit causal interpretation and may introduce self-perception bias.

8. Implications / Recommendations

Future studies should therefore employ longitudinal or experimental designs and combine self-reports with faculty feedback, direct observations, and performance-based measures of deep learning. Future research could also extend the model by examining variables such as learning motivation, academic self-efficacy, learning strategies, academic flexibility, and faculty support, and by testing interventions that integrate growth mindset development with academic engagement to promote deep learning.

Declarations

Ethical Approval and Consent

Institutional permission was obtained from the Faculty of Education, Tafahna Al-Ashraf, Al-Azhar University, on July 12, 2026. Written informed consent was obtained from all adult participants before participation. Participants were informed of their voluntary participation, right to withdraw, and the confidentiality and anonymity of their responses.

Funding

This research received no external funding.

Author Contribution

- Author Contributions: Conceptualization, (AH.Gh) and (YA.Ha); methodology, (AH.Gh); software, (YA.Ha); validation, (KH.YO) and (MA.IB); formal analysis, (AH.Gh); investigation, (MA.MO); data curation, (MO.FA); writing—original, draft preparation, (KH.YO) and (MA.IB); writing—review and editing, (NE.Ab.) and (YA.Ha); visualization, (NE.Ab.); supervision, (AH.Gh) and (MA.MO); project administration, (MO.FA).

Data Availability

77 93 126 78 98 130 73 118 150 100 67 93 48 108 147 96 120 90 50 [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 131 88 79 113 56 93 130 83 92 123 59 95 134 72 99 136 59 83 107 74 85 116 72 110 150 51 111 149 79 90 118 50 121 150 78 120 99 44 120 107 53 92 122 76 85 113 71 78 112 26 63 83 46 76 108 57 89 122 64 92 129 53 96 91 125 69 125 164 100 75 104 41 84 117 74 120 64 76 99 138 48 79 110 66 96 126 84 97 134 80 92 121 79 64 89 96 137 75 102 144 74 93 126 75 107 144 89 86 117 66 120 104 42 87 121 61 86 118 88 104 141 77 106 144 79 75 87 117 77 56 76 47 89 122 62 113 150 100 98 130 62 102 142 67 81 106 71 99 142 34 91 126 67 105 139 86 89 121 90 98 141 98 97 133 80 120 106 47 96 130 74 93 126 26 89 119 58 82 116 61 90 129 85 120 85 40 92 126 88 85 113 78 90 126 64 103 131 73 90 120 78 88 121 67 76 100 80 90 117 77 120 105 58 101 139 75 81 115 83 128 80 87 125 48 120 112 63 69 94 68 120 108 63 101 134 78 75 99 60 82 113 52 117 150 84 76 105 61 102 139 68 120 113 42 93 126 84 109 142 100 84 116 55 86 116 66 88 121 79 70 95 67 78 114 42 98 142 70 85 112 66 94 51 107 148 61 120 91 54 88 115 59 120 85 46 81 111 52 102 145 59 85 120 66 103 143 91 102 140 64 120 103 124 78 81 111 71 64 89 41 105 144 72 88 121 70 87 120 50 112 150 74 96 129 77 97 140 73 90 120 58 120 108 45 120 107 78 99 129 78 94 130 72 120 94 89 96 127 91 64 89 51 103 139 95 99 136 77 89 120 70 120 103 34 98 89 125 97 95 129 80 81 113 59 98 133 58 98 139 67 103 138 86 88 121 60 80 107 57 87 118 79 99 132 71 45 60 76 92 126 69 83 114 81 100 112 79 100 105 47 99 145 53 91 124 86 113 150 82 90 117 74 81 113 57 120 105 67 92 82 106 57 106 141 91 93 128 80 110 146 95 90 124 65 103 146 98 93 121 86 96 133 61 109 148 99 100 133 100 80 108 56 92 125 90 100 146 78 89 121 89 107 146 90 95 136 100 100 108 51 100 101 41 88 117 84 94 132 94 130 59 91 122 87 90 121 80 86 119 44 98 137 57 99 136 87 92 124 64 96 132 79 60 87 44 97 133 88 93 132 47 99 135 78 110 150 92 88 125 62 107 147 67 97 131 60 100 93 59 100 87 57 89 119 81 91 125 79 81 118 52 142 72 100 95 44 111 150 69 100 98 69 67 84 51 86 112 64 83 115 72 95 128 80 100 98 71 100 100 69 87 123 120 71 100 137 84 116 150 97 96 134 84 100 134 71 93 123 52 93 125 69 101 140 75 93 126 78 102 143 88 101 43 79 108 79 88 118 78 102 133 91 83 112 45 105 150 61 95 131 70 100 96 56 100 83 40 100 81 42 88 117 72 90 141 70 83 108 76 79 104 64 82 105 68 113 150 94 92 133 30 89 124 55 111 150 69 101 137 88 92 123 95 87 121 79 107 65 102 135 86 96 138 53 88 118 75 89 119 49 112 150 55 82 117 58 95 127 71 100 108 55 88 117 77 103 150 100 85 120 45 109 150 94 73 98 59 92 128 61 82 112 78 98 136 64 98 133 83 100 97 45 84 116 51 92 125 80 83 114 47 98 142 71 88 120 71 107 143 68 82 115 51 85 120 53 93 126 59 86 110 72 88 123 54 100 101 50 120 73 67 92 65 93 126 77 99 135 68 101 137 75 100 90 31 94 131 75 100 100 52 100 91 62 106 146 74 98 134 54 99 127 76 97 131 74 92 124 60 64 85 62 88 121 51 105 143 88 69 95 43 92 125 69 100 143 79 88 123 50 93 127 75 107 42 100 105 62 95 131 62 93 130 065 72 92 52 100 131 89 94 128 92 111 150 65 125 150 94 112 147 85 77 116 150 97 85 120 65 111 150 64 100 103 45 82 109 84 97 136 69 84 118 52 90 121 66 103 135 68 91 127 60 138 81 106 147 73 101 135 74 83 119 53 95 127 74 85 116 78 86 127 53 83 107 70 81 111 62 94 125 85 104 139 63 82 113 78 98 129 75 86 112 54 100 141 85 96 133 81 91 118 67 88 121 71 80 105 79 88 124 64 91 131 81 103 88 43 87 119 69 93 127 79 87 120 68 88 114 86 83 115 47 100 135 90 93 126 59 94 123 57 108 145 54 103 142 93 122 79 91 119 63 81 111 64 100 76 40 101 141 75 100 130 97 71 104 51 92 123 78 100 105 50 92 131 49 64 85 111 69 92 129 64 102 136 72 106 144 79 77 104 36 105 138 79 102 134 76 122 150 61 100 102 60 95 133 64 71 103 136 79 91 126 85 97 135 75 69 89 69 80 111 49 80 106 59 100 131 60 88 124 51 94 125 88 108 144 100 86 127 65 95 135 66 94 127 82 78 109 48 85 116 70 94 125 60 84 118 44 101 137 66 67 97 61 64 88 36 95 134 100 83 116 63 98 126 86 96 127 76 112 150 99 92 127 61 98 128 73 101 143 70 89 113 68 86 119 50 85 115 78 68 111 149 109 106 142 78 96 131 61 108 140 77 89 123 53 119 150 92 100 110 47 87 121 55 89 120 77 133 150 89 55 121 150 88 80 111 62 113 150 82 91 121 66 102 138 78 116 150 80 76 106 46 94 126 74 83 118 55 86 114 81 107 68 100

9. Disclosure Statement

One of the main strengths of the current study is its examination of the mediating role of academic engagement in the relationship between growth mindset and deep learning among prospective teachers. This goes beyond simply studying the direct relationships between these variables to revealing a mechanism by which learners' beliefs about their potential for growth influence the nature of their learning. This finding supports previous literature linking growth mindset to engagement, achievement, and persistence in learning, such as the studies by Yeager et al. (2019) and Larson (2023), as well as studies that have emphasized the importance of academic engagement in supporting deep learning, such as those by Goldspink and Foster (2013), Kahu (2013), and Chen and Zheng (2022). Another strength lies in testing the proposed model using path analysis, which allowed for the identification of both direct and indirect effects between variables.Institutional permission to administer the research instruments was obtained from the Administration of the Faculty of Education, Tafahna Al-Ashraf, Al-Azhar University, through the Office of the Dean on July 12, 2026. The institutional permission did not include a separate ethics approval or permit reference number. The study involved prospective teachers aged 18–22 years, Faculty of Education, Tafahna Al-Ashraf, Al-Azhar University, Egypt, all of whom were adults and capable of providing informed consent. Accordingly, written informed consent was obtained directly from all participants before participation, and parental or guardian consent was not required. Participants were informed about the purpose and procedures of the study, the voluntary nature of participation, their right to decline participation or withdraw at any time without penalty, and the measures taken to protect the confidentiality and anonymity of their responses. No personally identifiable information was reported, and the collected data were used solely for research purposes.

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Figures

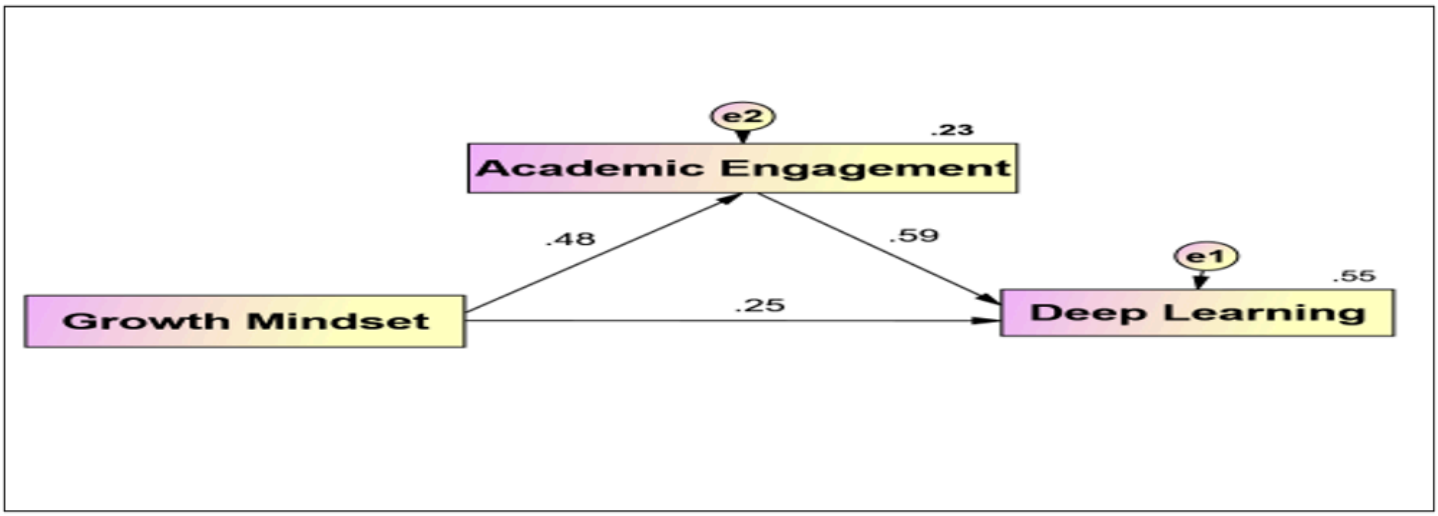


Figure 1

Shows the path analysis model extracted for the relationships between the research variables.