PRESENTING A CAUSAL MODEL FOR PREDICTING ACADEMIC ACHIEVEMENT BASED ON INTELLIGENCE BELIEFS AND SCIENTIFIC OPTIMISM MEDIATED BY ACADEMIC ENGAGEMENT AND SELF-EFFICACY

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Abstract

One of the important indicators of the efficiency of educational systems is to examine the learners' academic achievement and the related effective factors. This study aims to analyze the relationship between academic achievement, intelligence beliefs, scientific optimism, academic engagement, and academic self-efficacy in the form of a causal model. In this descriptive and correlational study, the population comprised all students at Kashan Paramedicine College in the 2022-2023 academic year, of which 247 students were selected through stratified random sampling. To collect data, Dupeyrat and Mariné's Intelligence Beliefs Questionnaire, Tschannen-Moran and his colleagues' Scientific Optimism Questionnaire, Zarang Academic Engagement Questionnaire, and McIlroy & Bunting Academic Self-Efficacy Questionnaire were used. Data were analyzed through descriptive and inferential statistics in the SPSS and Smart PLS statistics software. The results revealed significant correlations among intelligence beliefs, scientific optimism, academic engagement, academic self-efficacy, and students' academic achievement. In addition, intelligence beliefs and scientific optimism with the mediating role of academic engagement and academic self-efficacy had a significant indirect effect on academic achievement. These results emphasize the fundamental importance of intelligence beliefs, academic optimism, academic engagement, and self-efficacy in students' academic achievement.

Keywords: *academic achievement, intelligence beliefs, scientific optimism, academic engagement, academic self-efficacy*

1. INTRODUCTION

Training efficient students is one of the main issues and goals of higher education. Students are considered the intellectual and spiritual assets of each country and the study of their specific issues is one of the most important goals of government educational planners [1]. Improving educational quality and students' academic performance are two of the crucial goals of universities since poor performance imposes high financial and spiritual costs on both institutions and students [2]. In educational settings, academic achievement indicates how far a learner has achieved specific educational goals that have been the focus of educational activities [3].

Education professionals and researchers in various fields of human knowledge have always sought to identify the causes and factors affecting academic achievement. The study of theoretical principles suggests that various individual, social, family, economic and educational factors play a role in student's academic performance. Consequently, explaining factors related to the academic success of students is a significant research topic in higher education [4]. Academic achievement can be interrelated with variables such as intelligence beliefs, academic optimism, academic engagement, and self-efficacy.

Learners and educational settings must consider intelligence beliefs as motivational factors underpinning their motivation to succeed at higher levels [5]. Behavioral intelligence beliefs are the semantic systems that guide a person's behavior and allow others to predict it. Various studies have been conducted investigating the effect of intelligence beliefs on academic achievement [6-8]. [9] believe that intelligence beliefs are related to learners' academic achievement and create different cognitive-motivational frameworks for learners. Thus, incremental intelligence beliefs lead to a stronger sense of efficiency, advancement, reduction of fear of failure, raising the level of aspirations, and improving one's ability to solve problems and analytical thinking, consequently affecting learners' academic achievement [7]

Academic optimism is another factor related to academic performance [10]. Seligman's theory of "learned helplessness" introduced the concept of optimism to psychology [11]. Environmental factors can influence learners' academic optimism. The belief indicates if a friendly relationship is established between the learner and the teaching staff, academic emphasis is on the learners' progress, and subsequently, students have a sense identical with the setting, the individuals will have a high motivation to progress and ultimately achieve success [12]. The results of various studies suggest there is a significant relationship between academic optimism and academic performance; for instance, [13] in a study found that academic optimism has a positive and significant relationship with students' progress.

Academic engagement is another factor affecting the quality of education and students' academic achievement [14]. Academic engagement is conscious and purposeful participation in academic activities indicating a kind of psychological investment and learning facilitators along with satisfaction within individual effort that is devoted to the activity [15]. Students without academic engagement do not tend to participate in group work, do not perform class activities, and the classroom environment is not pleasant for them consequently, they are less successful in education and learning [16]. Many studies have shown that high levels of academic achievement and various components of academic engagement are strongly related [17]. Thus, paying attention to learners' academic engagement which is known as the basis of modification in education, is of particular importance and is one of the main factors affecting learners' academic performance.

Another variable that is effective in academic performance is called academic self-efficacy [18] which is one of the paramount predictors of learners' academic performance, their grades, and perseverance in learning [19]. Self-efficacy is an individual's belief about his or her ability to adopt one of the alternatives in their performance which influences the events occurring during their lifetime [20]. [21] states that learners with a high sense of self-efficacy set higher goals for themselves, demonstrate more flexibility when searching for solutions, achieve higher intelligence functions, and assess the quality of their performance more accurately than learners with equal cognitive ability. The results of many studies suggest that learners' beliefs about self-efficacy have positive effects on their motivation and academic achievement [22-24]. As a result, academic self-efficacy at higher levels leads to better average scores and consistency in doing and completing assignments, and subsequently, learners with higher academic self-efficacy have better academic adjustment

Academic achievement and intelligence beliefs can both be affected by self-efficacy. Studies have indicated that learners who believe in intelligence as an expandable skill and a component on which context and education affect have a higher self-efficacy [25, 26]. Similarly, Dweck argues that individuals who perceive ability as an intrinsic characteristic lose efficiency in dealing with problems, while individuals who perceive ability as a learned trait achieve greater efficiency and competence [27].

According to previous investigations, academic self-efficacy is also affected by scientific optimism. Various studies have reported that learners' academic optimism has an impact on their academic self-efficacy [28, 29]. [29, 30] also showed that high self-efficacy is associated with high self-esteem, health, optimism, better physical condition, better adaptation, and appropriate response to critical conditions. One study found a positive and significant relationship between self-efficacy and optimism with motivation to progress in sports [31].

The results of various studies [32-34] suggest there is also a significant relationship between academic optimism and academic engagement. They proposes that the student's expectation of success can be related to academic engagement

and increases the student's motivation for better performance. Academic engagement has positive consequences such as participation in learning activities, interaction with staff, teachers and other students, and interest in completing homework [35].

Another variable correlated with academic engagement is intelligence beliefs. This variable refers to how much learners believe intelligence is a constant or boosting trait [36]. Studies suggest that incremental belief in intelligence is positively related to student's academic engagement, and intrinsic belief in intelligence is negatively related [37]

According to the mentioned studies, it can be concluded that intelligence beliefs, scientific optimism, academic engagement, and self-efficacy play a vital and inevitable role in improving students' academic performance and achievement. However, a few researchers analyze and compare the mediating effect of self-efficacy and academic engagement on academic achievement regarding the relationship between intelligence beliefs and academic optimism in the form of a causal model. Therefore the current study was conducted to investigate the fit of the conceptual model of academic achievement based on beliefs of intelligence and scientific optimism with the mediating role of academic engagement and self-efficacy with the experimental model (Figure 1).
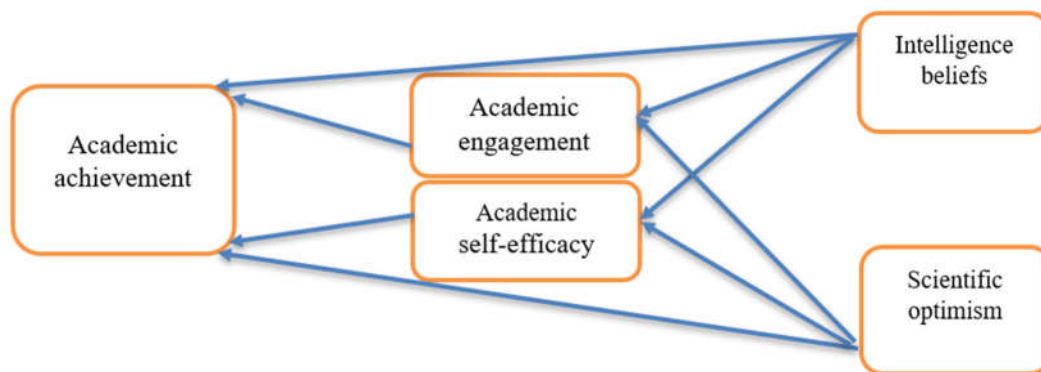

Figure1. A Conceptual model depicting the relations between intelligence beliefs, scientific optimism, academic engagement, academic self – efficacy, and academic achievement

2. Method
2.1. Participants and procedure
The present study was a descriptive-correlational study that was conducted in a paramedicine college in the 2022-2023 academic year. The statistical population comprised all students of the Kashan University of Medical Sciences from which 247 students (119 females and 128 males) were selected employing a stratified random sampling method. In this way after separating the different degrees, from each degree according to their total number, the frequency percentages have been determined, and then according to the frequency percentage in each educational degree, 10 classes from the undergraduate degree, 3 classes from the graduate degree and 1 class was selected from PhD degree and by referring to them, all the students of the selected classes entered the study. Participation was anonymous, voluntary and without compensation. Five standard tools including Intelligence Beliefs Questionnaire [38], Scientific Optimism Questionnaire [12], Academic Engagement Questionnaire [39] and Academic Self-Efficacy Questionnaire [40] were used to collect data. Students' academic achievements were evaluated based on their average marks.

2.2. Materials
2.2.1. Dupeyrat and Marine's Intelligence Beliefs Questionnaire
This instrument is a psychometric scale that uses a five-point Likert scale ranging from strongly agree (score one) to strongly disagree (score 5) to assess the respondent's agreement or disagreement. The subscale of intelligence beliefs includes 13 questions in three intrinsic dimensions (4 questions, from 1 to 4), incremental (5 questions, from 5 to 9), and effort (4 questions from 10 to 13). This tool in Iran by [41] has been reported with good validity and reliability. [42] reported Cronbach's alpha of 0.83 to measure the reliability of this scale.

2.2.2. Scientific Optimism Questionnaire
This questionnaire [12] has a five-point Likert scale from very low (1) to very high (5), which is designed to measure learners' academic optimism. The questionnaire has 28 items with three components include students' trust in teachers (questions 1-10), students' academic emphasis (questions 11-18), and students' sense of identity towards the school (questions 19-28) are assessed. The scoring of items 17, 23, and 24 is inverse. The validity and reliability of the questionnaire in the study of [12], for each of the subscales, is 0.93, 0.96, and 0.97, which indicates that the reliability of the questionnaire is desirable. The reliability of the questionnaire in [43] research for each of the subscales is 0.91, 0.86, 0.89, and 0.92 for the whole instrument, respectively.

2.2.3. Academic Engagement Questionnaire
A questionnaire prepared by [39] was used to measure academic engagement. This questionnaire has 38 items and 3 subscales such as cognitive conflict (19 items), motivational conflict (10 items), and behavioral conflict (9 items). The

options were adjusted based on a 5-point Likert scale from always true (5) to always false (1). Three experts in educational sciences verified the validity of the questionnaire by determining the validity of the content in terms of compliance with its theoretical basis. We then translated each of the components of academic engagement into words based on their theoretical foundations. Following a preliminary test using Cronbach's alpha in SPSS software, the academic engagement questionnaire showed an overall reliability of 0.92 with 38 questions in the introductory stage, the internal consistency of cognitive engagement subscales was 0.84, behavioral engagement was 0.76, and motivational involvement was 0.86. Additionally, the total reliability of the mentioned questionnaire in the final stage was calculated at 0.90, the internal consistency of the subscales of cognitive engagement 0.83, behavioral engagement 0.73, and motivational engagement 0.80, which was at a desirable and satisfactory level. Furthermore, construct validity was estimated through confirmatory factor analysis in which factor loads of 0.90, 0.69, and 0.90 were reported for the subscales of behavioral engagement, motivational engagement, and cognitive engagement, respectively.

2.2.4. Academic Self-Efficacy Questionnaire
The Self-Efficacy Questionnaire [44] consists of 10 questions that assess behaviors, programs, and academic organization. It's scoring on the Likert scale ranges from seven strongly agree (score 1) to strongly disagree (score 7). Questions 1, 2, 3, 4, 7, 8, and 10 are scored in reverse. McIlroy and Bunting reported the scale with a 0.81 reliability coefficient. Moreover, confirmatory factor analysis was used to assess validity, which indicates the questionnaire is appropriate to obtain data in this study. However, [45] retested this scale and reported a reliability coefficient of 0.42 as suspicious. The reliability coefficient of this scale has been calculated with the self-efficacy component of the Scale of Motivational Beliefs and Self-Regulated Learning Strategies as 0.71 [46].

2.3. Statistical analyses
To analyze the data, descriptive and inferential statistics were applied and, the partial least squared structural equation modeling (PLS-SEM) was used by Smartplsv3.2.8 software to evaluate the proposed model and assess research hypotheses.

3. Results
Participants included 247 students (119 females and 128 males) aged from 18 to 45. The mean, standard deviation (SD) of research variables are presented in Table 1.

Table 1: Mean and Standard Deviation of the study		
Variables	Mean	Std. Dev.
Intelligence beliefs	39.85	7.91
incremental intelligence beliefs	5.589	11.445
effort intelligence beliefs	6.568	15.822
Intrinsic intelligence beliefs	5.467	12.591
scientific optimism	88.48	32.47
Student trust in teachers	13.232	31.822
Student academic emphasis	10.525	25.34
student identification with school	12.719	31.324
academic engagement	119.70	44.31
Motivational academic engagement	13.342	31.154
Behavioral academic engagement	11.884	27.854
Cognitive academic engagement	24.644	60.7
academic self-efficacy	41.81	15.80
Academic achievement	16.14	2.08

Figure 2. Structural model of research with standard path coefficient values

Figure 2 shows the structural model based on the conceptual model with AVE values. As can be seen, the values of the standard path coefficients for all variables are less than the standard value of 0.05 and are at the desired level, the mean values of the extracted variance for all latent variables are greater than the standard value of 0.5.

path	VIF		direct effects						F^2
			Values				Confidence Interval		
	VIF	β	SD	t	sig	5%	95%		
Intelligence beliefs →Academic self- efficacy	3.932	0.263	0.097	2.709	0.003	0.103	0.415		0.052
Intelligence beliefs →Academic Engagement	3.937	0.405	0.065	6.276	p < .0001	0.295	0.504		0.143
Intelligence beliefs →Academic Achievement	4.635	0.205	0.101	2.036	0.021	0.033	0.364		0.021
Academic self-efficacy →Academic Achievement	2.971	0.25	0.085	2.938	0.002	0.106	0.386		0.048
Scientific Optimism →Academic self-efficacy	3.937	0.574	0.095	6.069	p < .0001	0.42	0.727		0.246
Scientific Optimism →Academic Engagement	3.937	0.466	0.066	7.058	p < .0001	0.362	0.576		0.189
Scientific Optimism →Academic Achievement	5.478	0.194	0.096	2.03	0.021	0.034	0.347		0.016
Academic Engagement →Academic Achievement	1.00	0.167	0.081	2.061	0.020	0.032	0.308		0.308
			Indirect Effects						
Intelligence beliefs →Academic self-efficacy →Academic Achievement	-	0.066	0.032	2.034	0.021	0.017	0.125		-
Intelligence beliefs →Academic Engagement →Academic Achievement	-	0.068	0.036	1.868	0.031	0.016	0.136		-
Scientific Optimism →Academic self-efficacy →Academic Achievement	-	0.143	0.056	2.552	0.005	0.056	0.244		-
Scientific Optimism →Academic Engagement →Academic Achievement	-	0.078	0.039	1.993	0.023	0.02	0.146		-

Table 2. Model fit results, Collinearity indices, direct and indirect effects

The results including the fitting of the model, collinearity indices, and direct and indirect effects of research variables are reported in Table 2. Accordingly, the direct effect of intelligence beliefs on academic achievement (β = 0.205, p =0.021), the direct effect of scientific optimism on academic achievement (β = 0.194, p= 0.021), the direct effect of academic engagement on Academic achievement (β = 0.167, p= 0.020) and the direct effect of academic self-efficacy on academic achievement (β = 0.25, p= 0.002) are all statistically significant at the error level of P <0.05. In addition, the direct effect of intelligence beliefs on academic engagement (β = 0.405, p < .0001), the direct effect of intelligence beliefs on academic self-efficacy (β = 0.263, p = 0.003), the direct effect of scientific optimism on academic engagement (β = .466, p < .0001), and the direct effect of scientific optimism on academic self-efficacy (β = 0.574, p < .0001) are statistically significant at the error level (p <0.01). The indirect effect of intelligence beliefs and scientific optimism on academic achievement due to academic engagement and academic self-efficacy is also significant at the error level (p <0.05). Therefore, all research hypotheses are confirmed.

The effect size (f2) indicates a change in the value (R2) after removing a certain exogenous latent variable from the model. [47] introduced the values of 0.02, 0.15, and 0.35 as a small, medium, and large effects, respectively. The results of the above table show that the effect of intelligence beliefs on self-efficacy (f2 = 0.052), intelligence beliefs on academic achievement (f2 = 0.021), self-efficacy on academic achievement (f2 = 0.048), scientific optimism on academic achievement (f2 = 0.016), academic engagement on academic achievement (f2 = 0.018) are all with small effect size while effect of intelligence beliefs on academic engagement (f2 = 0.143), scientific optimism on academic self-efficacy (f2 = 0.246), and scientific optimism on academic engagement (f2 = 0.189) are with average effect size.

Table 3 indicate that Cronbach's alpha value and the combined reliability of each of the research variables have been reported to be greater than 0.7, which indicates the appropriate reliability of the research model [48]. In this study, the AVE criterion (average variance extracted) was used to evaluate the convergent validity in which values greater than 0.5 for each variable indicate the appropriate convergent validity [48]. The results of the analysis confirm the appropriate convergent validity of the model.

Table 3: Results of three criteria of Cronbach's alpha, convergent reliability, and validity			
Variables	**Alpha > 0.7**	**Cr > 0. 7**	**AVE > 0.5**
Intelligence Beliefs	0.842	0.904	0.759
Scientific Optimism	0.867	0.919	0.79
Academic Engagement	0.852	0.91	0.772
Academic self-efficacy	0.891	0.911	0.508
Academic Achievement	1	1	1

Furthermore, to ensure the divergent validity of the questionnaires, the [49] method was used and the difference between the indices of one structure with those of other structures was calculated by comparing the AVE root of each structure with the values of correlation coefficients between structures.

Table 4 reported the related results. Acceptable divergent validity of a model indicates that a construct in the model interacts more with its indicators than with other constructs. Divergent validity is acceptable when the average variance extracted for each construct is greater than the correlation between that construct and other constructs in the model. In the case of all research structures, the numbers in the main diameter are higher than their lower values which confirms the divergent validity.

Table 4. Discriminant validity									
	1	2	3	4	5	6	7	8	9
student identification with school	**0.757**								
Student trust in teachers	0.716	**0.787**							
incremental intelligence beliefs	0.65	0.707	**0.774**						
effort intelligence beliefs	0.666	0.658	0.629	**0.821**					
Intrinsic intelligence beliefs	0.727	0.649	0.638	0.656	**0.816**				
Student academic emphasis	0.645	0.699	0.663	0.671	0.649	**0.776**			
Motivational academic engagement	0.671	0.676	0.628	0.679	0.649	0.643	**0.79**		
Behavioral academic engagement	0.626	0.581	0.567	0.578	0.578	0.61	0.627	**0.78**	
Cognitive academic engagement	0.662	0.65	0.615	0.647	0.636	0.631	0.684	0.671	**0.763**

As seen in the above matrix, the root mean of the extracted variance of all the first-order constructs is higher than the correlation value between them, which indicates the appropriate divergent validity and good fit of the research measurement models. Also, the results suggest that each construct in the research model interacts more with its indicators than other constructs. Finally, based on the obtained results, the reliability, convergent validity, and divergent validity of the research are confirmed and it is determined that the fit of the research measurement model is appropriate.

The goodness of Fit in the research model

Table 5. Model Fit		
variables	value	result
SRMR <0.08 [50]	0.050	Good
d-G <0.95 [51]	0.880	Good
NFI >0.25 [52]	0.840	Good
GOF >0.25 [52]	0.704	Good

The above table shows the fit indices of the research model. According to the obtained values, the data collected for the measurement of hidden variables have the necessary adequacy and fit, and as a result, the results obtained from the estimation of the research model are reliable and trustworthy.

4. Discussion

The present research has investigated the role of academic achievement based on intelligence beliefs and scientific optimism with the mediating role of academic engagement and self-efficacy among the students of Kashan Paramedicine College with the help of inferential statistics methods and structural equation modeling. The research findings indicate that the fit indices for confirmatory factor analysis models indicating all hidden variables are at a favorable level.

Research hypotheses have shown that incremental intelligence beliefs, intrinsic intelligence beliefs and effort, student trust in teachers, academic emphasis, and student identification at school are directly related to academic self-efficacy and academic engagement, and also directly and indirectly to academic achievement for students. In other words, Students' sense of efficacy has increased and they are more engaged in academic affairs to the extent that their beliefs in intelligence and scientific optimism are strengthened and as a result, they progress more in academic settings. Regarding the positive and significant effect of intelligence beliefs on academic achievement, the findings of the research are consistent with the results of [7, 38, 53]. Students who believe that their intelligence can be increased are more motivated and attempt more in different ways to achieve academic success.

The direct effect of scientific optimism on academic achievement was another research finding that is consistent with the results of studies carried out by [13, 54-56]. That is people with high optimism are confident they will achieve their goals in the future which leads to positive thoughts, and they in turn lead to more positive emotions and motivation resulting in success and high performance [57].

Furthermore, findings showed the direct effect of academic engagement on academic achievement. This finding is consistent with the results of [58-61]. [59] consider student engagement as one of the best predictors of personal learning

and development. It is assumed that the more learners study or practice a topic, the more they are likely to learn and need to become more proficient.

The direct effect of academic self-efficacy on academic achievement is another research finding which in line with [62-65]. In fact, academic self-efficacy beliefs affect learners' behavior, choices, actions, perseverance, and resilience spent on an activity. Academic self-efficacy also affects the level of stress and anxiety and ultimately the students' success rate. The greater the sense of efficiency, the greater learners' effort, perseverance, and resilience. Learners with strong competitive personalities perceive difficult tasks as a challenge to overcome, rather than threats to be avoided, and handle them with a positive attitude. In contrast, learners with low academic self-efficacy perceive situations or tasks as more difficult than they are, which in turn reinforces feelings of stress, depression, and hopelessness [66].

Findings demonstrated that intelligence beliefs had a direct effect on academic engagement which is consistent with research findings of [67-69]. Researchers have declared that intelligence beliefs are associated with learners' performance at all levels of education: the more engagement learners experience, the better their academic performance will be. In explaining the above hypothesis, [68] concluded that students' cognitive engagement regarding homework is influenced by their intelligence beliefs.

The direct effect of intelligence beliefs on academic self-efficacy was another research finding that is in consistent with the results of [26, 70, 71]. Explaining this finding, [72] believes that people with incremental intelligence beliefs have a more positive image of their abilities and competencies, and as a result, their self-efficacy is higher in the majority of fields compared to learners with inherent intelligence beliefs. Learners with incremental intelligence beliefs to improve their intelligence and abilities lead to more hope and effort and more success, as a result.

The findings indicated that scientific optimism has a direct effect on academic engagement. This finding is in line with the results of the research of [32-34].With a sense of identity in the university, students have a sense of belonging to their university and value the university and its related goals. Therefore, these students will show high academic engagement. Furthermore, the experience of positive emotions prepares students for effective and active participation in classroom activities and allows them to be optimistic about their capabilities and abilities, to perform well in education, and to show high academic engagement.

The findings of the research also confirmed the direct effect of scientific optimism on self-efficacy, which is in consistent with [30, 31, 73]. Clarifying this hypothesis, it can be said that since the structure of academic optimism has been formed using the theoretical foundations of Albert Bandura's social cognition, social self-efficacy, Seligman's concept of acquired optimism, culture and organizational climate, positive psychology, as well as Coleman's theory of social capital and participation [74], the results, as expected, indicate that the higher the scientific optimism of students, the higher the level of academic self-efficacy and, accordingly, their academic progress. Therefore, having a positive and optimistic view towards the educational environment, professors, classes, and the prevailing atmosphere of the university can persuade students to achieve their academic goals in the above-mentioned environment.

The indirect effect of intelligence beliefs on academic achievement through the mediation of academic engagement is another finding of the present study, which is consistent with the results of other researchers, including [75-77]. In general, when the learner has appropriate intelligence beliefs and is properly involved in the learning process, he can successfully overcome academic and non-academic challenges and ultimately achieve success.

Another finding of the research was the indirect effect of intelligence beliefs on academic achievement through the mediation of academic self-efficacy. This finding is in line with the results of the previous research such as [72, 78, 79] . [72] in his research on American teenagers concluded that teenagers with increased intelligence beliefs have a more positive image of their abilities and competencies, and as a result, their self-efficacy in most academic fields is higher compared to learners who believe in innate intelligence beliefs. On the other hand, [79] stated people who believe in incremental intelligence are more hopeful to succeed in challenging situations, due to the success they experience in various fields, which fosters their self-efficacy. Increasing self-efficacy also leads to greater academic success.

The findings of the present study demonstrated that academic optimism mediated by academic engagement had an indirect effect on academic achievement. This research finding is consistent with the results of [80-82]. According to these researchers, academic engagement plays a mediating role in academic achievement. When the learner feels confident and belonged to the educational environment, and teachers and classmates he will enjoy learning activities and tasks, has a greater internal motivation to accomplish the task rather than before doing it and deals with academic matters with more attention and control which leads to more academic efforts and as a result to his better performance [82].

The indirect effect of scientific optimism on academic achievement through the mediation of academic self-efficacy was also one of the other findings of the research, which was consistent with the findings of [73, 83, 84]. Optimistic individuals control difficult situations such as exam conditions due to their internal and positive documentation style, and pessimistic thoughts which are one of the main causes of anxiety are less likely to come to their minds. These learners reduce the

tension related to the exam by using more adaptive methods of facing problems and hoping to get a favorable results. As a result, they achieve more success compared to pessimistic ones [85].

Limitations and strengths
In the current study, demographic factors (such as age, gender, and economic background) and students' educational grades were not taken into account. A key feature of the study is a comparison of grade levels of self-efficacy, intelligence beliefs, scientific optimism, automaticity, and academic engagement.. As a final limitation, there was no study conducted with university students and higher education centers analyzing and comparing the mediating effect of self-efficacy and academic involvement on the relationship between intelligence belief and scientific optimism with academic progress. Nevertheless, the strength of this study was the use of structural equation modeling which, in the causal framework, provided a more complete picture of the complexity of the relationship between intelligence beliefs, scientific optimism, engagement, academic self-efficacy, and academic progress. This study also emphasized the fundamental importance of intelligence beliefs, academic optimism, academic engagement, and self-efficacy in college education.

5. Conclusion
The findings indicated the scores of intelligence beliefs, scientific optimism, self-efficacy, and academic engagement had a significant relationship with academic achievement. The present study provided useful results for parents, professors, and managers of educational systems in terms of how they can behave in encouraging students' intelligence beliefs. It is therefore important to consider students' intelligence beliefs in academic progress, as well as provide educational environments that promote learners' increased intelligence beliefs. A psychological support system and counseling center at universities is also recommended to enhance students' motivation (such as self-efficacy) and social factors (such as teacher support and supportive environments), which leads to greater academic engagement and participation.

Data availability
Data will be made available on request

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